

**2019**

 **FRM**®

Learning  
Objectives



The Global Association of Risk Professionals (GARP®) created the Financial Risk Manager (FRM®) Learning Objectives document to provide a comprehensive resource for those interested in becoming Certified FRMs.

### **FRM LEARNING OBJECTIVES**

The FRM is a comprehensive exam and you are expected to be familiar with a broad range of risk management concepts and techniques. Key concepts appear in the Study Guide as bullet points at the beginning of each section to help you identify the major themes and knowledge domains associated with the readings listed under each section. The Learning Objectives document builds upon the Study Guide and highlights more details around the recommended readings as well as specific learning objectives associated with each section of the knowledge domains covered by the Exam. Approximate weightings for each knowledge domain are assigned to help you navigate through the self-study process as these learning objectives form the backbone of the Exam itself; therefore, it is strongly suggested that you become familiar with these learning objectives as you review the readings.

FRM  
LEARNING  
OBJECTIVES  
PART I

# Foundations of Risk Management

## PART I EXAM WEIGHT | 20% (FRM)

### THE BROAD AREAS OF KNOWLEDGE COVERED IN READINGS RELATED TO FOUNDATIONS OF RISK MANAGEMENT INCLUDE THE FOLLOWING:

- Basic risk types, measurement and management tools
- Creating value with risk management
- The role of risk management in corporate governance
- Enterprise Risk Management (ERM)
- Financial disasters and risk management failures
- The Capital Asset Pricing Model (CAPM)
- Risk-adjusted performance measurement
- Multifactor models
- Data aggregation and risk reporting
- Ethics and the GARP Code of Conduct

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*The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:*

**Michel Crouhy, Dan Galai, and Robert Mark, *The Essentials of Risk Management, 2<sup>nd</sup> Edition* (New York, NY: McGraw-Hill, 2014).**

#### **Chapter 1. Risk Management: A Helicopter View (Including Appendix 1.1) [FRM-1]**

*After completing this reading you should be able to:*

- Explain the concept of risk and compare risk management with risk taking.
- Describe the risk management process and identify problems and challenges that can arise in the risk management process.
- Evaluate and apply tools and procedures used to measure and manage risk, including quantitative measures, qualitative assessment, and enterprise risk management.
- Distinguish between expected loss and unexpected loss, and provide examples of each.
- Interpret the relationship between risk and reward and explain how conflicts of interest can impact risk management.
- Describe and differentiate between the key classes of risks, explain how each type of risk can arise, and assess the potential impact of each type of risk on an organization.

#### **Chapter 2. Corporate Risk Management: A Primer [FRM-2]**

*After completing this reading you should be able to:*

- Evaluate some advantages and disadvantages of hedging risk exposures.
- Apply appropriate methods to hedge operational and financial risks, including pricing, foreign currency, and interest rate risk.
- Explain how a company can determine whether to hedge specific risk factors, including the role of the board of directors and the process of mapping risks.
- Assess the impact of risk management instruments.

**Chapter 4. Corporate Governance and Risk Management [FRM-3]***After completing this reading you should be able to:*

- Compare and contrast best practices in corporate governance with those of risk management.
- Assess the role and responsibilities of the board of directors in risk governance.
- Evaluate the relationship between a firm's risk appetite and its business strategy, including the role of incentives.
- Distinguish the different mechanisms for transmitting risk governance throughout an organization.
- Illustrate the interdependence of functional units within a firm as it relates to risk management.
- Assess the role and responsibilities of a firm's audit committee.

**James Lam, *Enterprise Risk Management: From Incentives to Controls*, 2<sup>nd</sup> Edition (Hoboken, NJ: John Wiley & Sons, 2014).**

**Chapter 4. What is ERM? [FRM-4]***After completing this reading you should be able to:*

- Describe Enterprise Risk Management (ERM) and compare and contrast differing definitions of ERM.
- Compare the benefits and costs of ERM and describe the motivations for a firm to adopt an ERM initiative.
- Describe the role and responsibilities of a Chief Risk Officer (CRO) and assess how the CRO should interact with other senior management.
- Describe the key components of an ERM program.

**René Stulz, "Risk Management, Governance, Culture and Risk Taking in Banks," FRBNY Economic Policy Review, (August 2016): 43–59. [FRM-5]**

*After completing this reading you should be able to:*

- Assess methods that banks can use to determine their optimal level of risk exposure, and explain how the optimal level of risk can differ across banks.
- Describe implications for a bank if it takes too little or too much risk compared to its optimal level.
- Explain ways in which risk management can add or destroy value for a bank.
- Describe structural challenges and limitations to effective risk management, including the use of Value at Risk (VaR) in setting limits.
- Assess the potential impact of a bank's governance, incentive structure, and risk culture on its risk profile and its performance.

**Steve Allen, *Financial Risk Management: A Practitioner's Guide to Managing Market and Credit Risk*, 2<sup>nd</sup> Edition (New York, NY: John Wiley & Sons, 2013).**

**Chapter 4. Financial Disasters [FRM-6]***After completing this reading you should be able to:*

- Analyze the key factors that led to and derive the lessons learned from the following risk management case studies:
  - Chase Manhattan and their involvement with Drysdale Securities
  - Kidder Peabody
  - Barings
  - Allied Irish Bank
  - Union Bank of Switzerland (UBS)
  - Société Générale
  - Long-Term Capital Management (LTCM)
  - Metallgesellschaft
  - Bankers Trust
  - JPMorgan, Citigroup, and Enron

**Markus K. Brunnermeier, “Deciphering the Liquidity and Credit Crunch 2007–2008,” *Journal of Economic Perspectives* (2009): 23(1), 77–100. [FRM–7]**

*After completing this reading you should be able to:*

- Describe the key factors that contributed to the lending boom and housing frenzy.
- Explain the banking industry trends leading up to the financial crisis and assess the triggers for the liquidity crisis.
- Describe how securitized and structured products were used by investor groups and describe the consequences of their increased use.
- Describe the economic mechanisms through which the mortgage crisis amplified into a financial crisis.
- Distinguish between funding liquidity and market liquidity and explain how the evaporation of liquidity can lead to a financial crisis.
- Analyze how an increase in counterparty credit risk can generate additional funding needs and possible systemic risk.

**Gary Gorton and Andrew Metrick, “Getting Up to Speed on the Financial Crisis: A One-Weekend-Reader’s Guide,” *Journal of Economic Literature* (2012): 50(1), 128–150. [FRM–8]**

*After completing this reading you should be able to:*

- Describe the historical background and provide an overview of the 2007–2009 financial crisis.
- Describe the build-up to the financial crisis and the factors that played an important role.
- Assess the consequences of the Lehman failure on the global financial markets.
- Describe the historical background leading to the recent financial crisis.
- Distinguish between the two main panic periods of the financial crisis and describe the state of the markets during each.
- Assess the governmental policy responses to the financial crisis and review their short-term impact.
- Describe the global effects of the financial crisis on firms and the real sector of the economy.

**René Stulz, “Risk Management Failures: What Are They and When Do They Happen?” *Journal of Applied Corporate Finance* 20, No. 4 (2008): 39–48. [FRM–9]**

*After completing this reading you should be able to:*

- Explain how a large financial loss may not necessarily be evidence of a risk management failure.
- Analyze and identify instances of risk management failure.
- Explain how risk management failures can arise in the following areas: measurement of known risk exposures, identification of risk exposures, communication of risks, and monitoring of risks.
- Evaluate the role of risk metrics and analyze the shortcomings of existing risk metrics.

**Edwin J. Elton, Martin J. Gruber, Stephen J. Brown and William N. Goetzmann, *Modern Portfolio Theory and Investment Analysis*, 9<sup>th</sup> Edition (Hoboken, NJ: John Wiley & Sons, 2014).**

**Chapter 13. The Standard Capital Asset Pricing Model [FRM–10]**

*After completing this reading you should be able to:*

- Understand the derivation and components of the CAPM.
- Describe the assumptions underlying the CAPM.
- Interpret the capital market line.
- Apply the CAPM in calculating the expected return on an asset.
- Interpret beta and calculate the beta of a single asset or portfolio.

**Noel Amenc and Veronique Le Sourd, *Portfolio Theory and Performance Analysis* (West Sussex, UK: John Wiley & Sons, 2003).**

**Chapter 4. Applying the CAPM to Performance Measurement: Single-Index Performance Measurement Indicators (Section 4.2 only) [FRM-11]**

*After completing this reading you should be able to:*

- Calculate, compare, and evaluate the Treynor measure, the Sharpe measure, and Jensen's alpha.
- Compute and interpret tracking error, the information ratio, and the Sortino ratio.

**Zvi Bodie, Alex Kane, and Alan J. Marcus, *Investments, 11<sup>th</sup> Edition* (New York, NY: McGraw-Hill, 2017).**

**Chapter 10. Arbitrage Pricing Theory and Multifactor Models of Risk and Return [FRM-12]**

*After completing this reading you should be able to:*

- Describe the inputs, including factor betas, to a multifactor model.
- Calculate the expected return of an asset using a single-factor and a multifactor model.
- Describe properties of well-diversified portfolios and explain the impact of diversification on the residual risk of a portfolio.
- Explain how to construct a portfolio to hedge exposure to multiple factors.
- Describe and apply the Fama-French three factor model in estimating asset returns.

**“Principles for Effective Data Aggregation and Risk Reporting,” (Basel Committee on Banking Supervision Publication, January 2013). [FRM-13]**

*After completing this reading you should be able to:*

- Explain the potential benefits of having effective risk data aggregation and reporting.
- Describe key governance principles related to risk data aggregation and risk reporting practices.
- Identify the governance framework, risk data architecture and IT infrastructure features that can contribute to effective risk data aggregation and risk reporting practices.
- Describe characteristics of a strong risk data aggregation capability and demonstrate how these characteristics interact with one another.
- Describe characteristics of effective risk reporting practices.
- Describe the role that supervisors play in the monitoring and implementation of the risk data aggregation and reporting practices.

**GARP Code of Conduct.\* [FRM-14]**

*After completing this reading you should be able to:*

- Describe the responsibility of each GARP Member with respect to professional integrity, ethical conduct, conflicts of interest, confidentiality of information, and adherence to generally accepted practices in risk management.
- Describe the potential consequences of violating the GARP Code of Conduct.

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\*This reading is freely available on the GARP website.

# Quantitative Analysis

## PART I EXAM WEIGHT | 20% (QA)

### THE BROAD AREAS OF KNOWLEDGE COVERED IN READINGS RELATED TO QUANTITATIVE ANALYSIS INCLUDE THE FOLLOWING:

- Discrete and continuous probability distributions
- Estimating the parameters of distributions
- Population and sample statistics
- Bayesian analysis
- Statistical inference and hypothesis testing
- Estimating correlation and volatility using EWMA and GARCH models
- Volatility term structures
- Correlations and copulas
- Linear regression with single and multiple regressors
- Time series analysis and forecasting
- Simulation methods

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*The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:*

**Michael Miller, *Mathematics and Statistics for Financial Risk Management, 2<sup>nd</sup> Edition* (Hoboken, NJ: John Wiley & Sons, 2013).**

#### **Chapter 2. Probabilities [QA-1]**

*After completing this reading you should be able to:*

- Describe and distinguish between continuous and discrete random variables.
- Define and distinguish between the probability density function, the cumulative distribution function, and the inverse cumulative distribution function.
- Calculate the probability of an event given a discrete probability function.
- Distinguish between independent and mutually exclusive events.
- Define joint probability, describe a probability matrix, and calculate joint probabilities using probability matrices.
- Define and calculate a conditional probability, and distinguish between conditional and unconditional probabilities.

#### **Chapter 3. Basic Statistics [QA-2]**

*After completing this reading you should be able to:*

- Interpret and apply the mean, standard deviation, and variance of a random variable.
- Calculate the mean, standard deviation, and variance of a discrete random variable.
- Interpret and calculate the expected value of a discrete random variable.
- Calculate and interpret the covariance and correlation between two random variables.
- Calculate the mean and variance of sums of variables.
- Describe the four central moments of a statistical variable or distribution: mean, variance, skewness, and kurtosis.
- Interpret the skewness and kurtosis of a statistical distribution, and interpret the concepts of coskewness and cokurtosis.
- Describe and interpret the best linear unbiased estimator.



**Chapter 4. Distributions [QA-3]***After completing this reading you should be able to:*

- Distinguish the key properties among the following distributions: uniform distribution, Bernoulli distribution, Binomial distribution, Poisson distribution, normal distribution, lognormal distribution, Chi-squared distribution, Student's t-distribution, and F-distributions, and identify common occurrences of each distribution.
- Describe the central limit theorem and the implications it has when combining independent and identically distributed (i.i.d.) random variables.
- Describe i.i.d. random variables and the implications of the i.i.d. assumption when combining random variables.
- Describe a mixture distribution and explain the creation and characteristics of mixture distributions.

**Chapter 6. Bayesian Analysis (pages 113-124 only) [QA-4]***After completing this reading you should be able to:*

- Describe Bayes' theorem and apply this theorem in the calculation of conditional probabilities.
- Compare the Bayesian approach to the frequentist approach.
- Apply Bayes' theorem to scenarios with more than two possible outcomes and calculate posterior probabilities.

**Chapter 7. Hypothesis Testing and Confidence Intervals [QA-5]***After completing this reading you should be able to:*

- Calculate and interpret the sample mean and sample variance.
- Construct and interpret a confidence interval.
- Construct an appropriate null and alternative hypothesis, and calculate an appropriate test statistic.
- Differentiate between a one-tailed and a two-tailed test and identify when to use each test.
- Interpret the results of hypothesis tests with a specific level of confidence.
- Demonstrate the process of backtesting VaR by calculating the number of exceedances.

**James Stock and Mark Watson, *Introduction to Econometrics, Brief Edition* (Boston, MA: Pearson, 2008).****Chapter 4. Linear Regression with One Regressor [QA-6]***After completing this reading you should be able to:*

- Explain how regression analysis in econometrics measures the relationship between dependent and independent variables.
- Interpret a population regression function, regression coefficients, parameters, slope, intercept, and the error term.
- Interpret a sample regression function, regression coefficients, parameters, slope, intercept, and the error term.
- Describe the key properties of a linear regression.
- Define an ordinary least squares (OLS) regression and calculate the intercept and slope of the regression.
- Describe the method and three key assumptions of OLS for estimation of parameters.
- Summarize the benefits of using OLS estimators.
- Describe the properties of OLS estimators and their sampling distributions, and explain the properties of consistent estimators in general.
- Interpret the explained sum of squares, the total sum of squares, the residual sum of squares, the standard error of the regression, and the regression  $R^2$ .
- Interpret the results of an OLS regression.

**Chapter 5. Regression with a Single Regressor [QA-7]***After completing this reading you should be able to:*

- Calculate and interpret confidence intervals for regression coefficients.
- Interpret the p-value.
- Interpret hypothesis tests about regression coefficients.
- Evaluate the implications of homoskedasticity and heteroskedasticity.
- Determine the conditions under which the OLS is the best linear conditionally unbiased estimator.
- Explain the Gauss-Markov Theorem and its limitations, and alternatives to the OLS.
- Apply and interpret the t-statistic when the sample size is small.

**Chapter 6. Linear Regression with Multiple Regressors [QA-8]***After completing this reading you should be able to:*

- Define and interpret omitted variable bias, and describe the methods for addressing this bias.
- Distinguish between single and multiple regression.
- Interpret the slope coefficient in a multiple regression.
- Describe homoskedasticity and heteroskedasticity in a multiple regression.
- Describe the OLS estimator in a multiple regression.
- Calculate and interpret measures of fit in multiple regression.
- Explain the assumptions of the multiple linear regression model.
- Explain the concepts of imperfect and perfect multicollinearity and their implications.

**Chapter 7. Hypothesis Tests and Confidence Intervals in Multiple Regression [QA-9]***After completing this reading you should be able to:*

- Construct, apply, and interpret hypothesis tests and confidence intervals for a single coefficient in a multiple regression.
- Construct, apply, and interpret joint hypothesis tests and confidence intervals for multiple coefficients in a multiple regression.
- Interpret the F-statistic.
- Interpret tests of a single restriction involving multiple coefficients.
- Interpret confidence sets for multiple coefficients.
- Identify examples of omitted variable bias in multiple regressions.
- Interpret the  $R^2$  and adjusted  $R^2$  in a multiple regression.

**Francis X. Diebold, *Elements of Forecasting, 4<sup>th</sup> Edition* (Mason, OH: Cengage Learning, 2006).****Chapter 5. Modeling and Forecasting Trend [QA-10]***After completing this reading you should be able to:*

- Describe linear and nonlinear trends.
- Describe trend models to estimate and forecast trends.
- Compare and evaluate model selection criteria, including mean squared error (MSE),  $s^2$ , the Akaike information criterion (AIC), and the Schwarz information criterion (SIC).
- Explain the necessary conditions for a model selection criterion to demonstrate consistency.

**Chapter 6. Modeling and Forecasting Seasonality [QA-11]***After completing this reading you should be able to:*

- Describe the sources of seasonality and how to deal with it in time series analysis.
- Explain how to use regression analysis to model seasonality.
- Explain how to construct an h-step-ahead point forecast.

**Chapter 7. Characterizing Cycles [QA-12]***After completing this reading you should be able to:*

- Define covariance stationary, autocovariance function, autocorrelation function, partial autocorrelation function, and autoregression.
- Describe the requirements for a series to be covariance stationary.
- Explain the implications of working with models that are not covariance stationary.
- Define white noise, and describe independent white noise and normal (Gaussian) white noise.
- Explain the characteristics of the dynamic structure of white noise.
- Explain how a lag operator works.
- Describe Wold's theorem.
- Define a general linear process.
- Relate rational distributed lags to Wold's theorem.
- Calculate the sample mean and sample autocorrelation, and describe the Box-Pierce Q-statistic and the Ljung-Box Q-statistic.
- Describe sample partial autocorrelation.

**Chapter 8. Modeling Cycles: MA, AR, and ARMA Models [QA-13]***After completing this reading you should be able to:*

- Describe the properties of the first-order moving average (MA(1)) process, and distinguish between autoregressive representation and moving average representation.
- Describe the properties of a general finite-order process of order  $q$  (MA( $q$ )) process.
- Describe the properties of the first-order autoregressive (AR(1)) process, and define and explain the Yule-Walker equation.
- Describe the properties of a general  $p$ th order autoregressive (AR( $p$ )) process.
- Define and describe the properties of the autoregressive moving average (ARMA) process.
- Describe the application of AR and ARMA processes.

**John C. Hull, *Risk Management and Financial Institutions, 5<sup>th</sup> Edition* (Hoboken, NJ: John Wiley & Sons, 2018).****Chapter 10. Volatility [QA-14]***After completing this reading you should be able to:*

- Define and distinguish between volatility, variance rate, and implied volatility.
- Describe the power law.
- Explain how various weighting schemes can be used in estimating volatility.
- Apply the exponentially weighted moving average (EWMA) model to estimate volatility.
- Describe the generalized autoregressive conditional heteroskedasticity (GARCH( $p,q$ )) model for estimating volatility and its properties.
- Calculate volatility using the GARCH(1,1) model.
- Explain mean reversion and how it is captured in the GARCH(1,1) model.
- Explain the weights in the EWMA and GARCH(1,1) models.
- Explain how GARCH models perform in volatility forecasting.
- Describe the volatility term structure and the impact of volatility changes.

**Chapter 11. Correlations and Copulas [QA-15]***After completing this reading you should be able to:*

- Define correlation and covariance and differentiate between correlation and dependence.
- Calculate covariance using the EWMA and GARCH(1,1) models.
- Apply the consistency condition to covariance.
- Describe the procedure of generating samples from a bivariate normal distribution.
- Describe properties of correlations between normally distributed variables when using a one-factor model.
- Define copula and describe the key properties of copulas and copula correlation.
- Explain tail dependence.
- Describe Gaussian copula, Student's t-copula, multivariate copula, and one-factor copula.

**Chris Brooks, *Introductory Econometrics for Finance, 3<sup>rd</sup> Edition* (Cambridge, UK: Cambridge University Press, 2014).****Chapter 13. Simulation Methods [QA-16]***After completing this reading you should be able to:*

- Describe the basic steps to conduct a Monte Carlo simulation.
- Describe ways to reduce Monte Carlo sampling error.
- Explain how to use antithetic variate technique to reduce Monte Carlo sampling error.
- Explain how to use control variates to reduce Monte Carlo sampling error and when it is effective.
- Describe the benefits of reusing sets of random number draws across Monte Carlo experiments and how to reuse them.
- Describe the bootstrapping method and its advantage over Monte Carlo simulation.
- Describe the pseudo-random number generation method and how a good simulation design alleviates the effects the choice of the seed has on the properties of the generated series.
- Describe situations where the bootstrapping method is ineffective.
- Describe disadvantages of the simulation approach to financial problem solving.

# Financial Markets and Products

## PART I EXAM WEIGHT | 30% (FMP)

### THE BROAD AREAS OF KNOWLEDGE COVERED IN READINGS RELATED TO FINANCIAL MARKETS AND PRODUCTS INCLUDE THE FOLLOWING:

- Structures and functions of financial institutions
- Structure and mechanics of OTC and exchange markets
- Structure, mechanics, and valuation of forwards, futures, swaps, and options
- Hedging with derivatives
- Interest rates and measures of interest rate sensitivity
- Foreign exchange risk
- Corporate bonds
- Mortgage-backed securities

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*The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:*

**John C. Hull, *Risk Management and Financial Institutions*, 5<sup>th</sup> Edition (Hoboken, NJ: John Wiley & Sons, 2018).**

#### **Chapter 2. Banks [FMP-1]**

***After completing this reading you should be able to:***

- Identify the major risks faced by a bank.
- Evaluate the capital requirements for banks.
- Distinguish between economic capital and regulatory capital.
- Explain how deposit insurance gives rise to a moral hazard problem.
- Describe investment banking financing arrangements including private placement, public offering, best efforts, firm commitment, and Dutch auction approaches.
- Describe the potential conflicts of interest among commercial banking, securities services, and investment banking divisions of a bank and recommend solutions to the conflict of interest problems.
- Describe the distinctions between the “banking book” and the “trading book” of a bank.
- Explain the originate-to-distribute model of a bank and discuss its benefits and drawbacks.

#### **Chapter 3. Insurance Companies and Pension Plans [FMP-2]**

***After completing this reading you should be able to:***

- Describe the key features of the various categories of insurance companies and identify the risks facing insurance companies.
- Describe the use of mortality tables and calculate the premium payment and the expected payout for a policy holder.
- Calculate and interpret loss ratio, expense ratio, combined ratio, and operating ratio for a property-casualty insurance company.
- Describe moral hazard and adverse selection risks facing insurance companies, provide examples of each, and describe how to overcome the problems.
- Distinguish between mortality risk and longevity risk and describe how to hedge these risks.
- Evaluate the capital requirements for life insurance and property-casualty insurance companies.
- Compare the guaranty system and the regulatory requirements for insurance companies with those for banks.
- Describe a defined benefit plan and a defined contribution plan for a pension fund and explain the differences between them.

**Chapter 4. Mutual Funds, ETFs, and Hedge Funds [FMP-3]***After completing this reading you should be able to:*

- Differentiate among open-end mutual funds, closed-end mutual funds, and exchange-traded funds (ETFs).
- Calculate the net asset value (NAV) of an open-end mutual fund.
- Distinguish between active and passive management and define alpha.
- Explain the key differences between hedge funds and mutual funds.
- Calculate the return on a hedge fund investment and explain the incentive fee structure of a hedge fund including the terms hurdle rate, high-water mark, and clawback.
- Describe various hedge fund strategies, including long/short equity, dedicated short, distressed securities, merger arbitrage, convertible arbitrage, fixed income arbitrage, emerging markets, global macro, and managed futures, and identify the risks faced by hedge funds.
- Describe hedge fund performance and explain the effect of measurement biases on performance measurement.

**John C. Hull, *Options, Futures, and Other Derivatives, 10<sup>th</sup> Edition* (New York, NY: Pearson, 2017).****Chapter 1. Introduction [FMP-4]***After completing this reading you should be able to:*

- Describe the over-the-counter market, distinguish it from trading on an exchange, and evaluate its advantages and disadvantages.
- Differentiate between options, forwards, and futures contracts.
- Identify and calculate option and forward contract payoffs.
- Calculate and compare the payoffs from hedging strategies involving forward contracts and options.
- Calculate and compare the payoffs from speculative strategies involving futures and options.
- Calculate an arbitrage payoff and describe how arbitrage opportunities are temporary.
- Describe some of the risks that can arise from the use of derivatives.
- Differentiate among the broad categories of traders: hedgers, speculators, and arbitrageurs.

**Chapter 2. Futures Markets and Central Counterparties [FMP-5]***After completing this reading you should be able to:*

- Define and describe the key features of a futures contract, including the asset, the contract price and size, delivery, and limits.
- Explain the convergence of futures and spot prices.
- Explain the operation of a margin account and describe the rationale for margin requirements.
- Describe the role of a clearinghouse in futures and over-the-counter market transactions.
- Describe the role of central counterparties (CCPs) and distinguish between bilateral and centralized clearing.
- Describe the role of collateralization in the over-the-counter market and compare it to the margining system.
- Identify the differences between a normal and inverted futures market.
- Explain the different market quotes, and describe trading volume and open interest.
- Describe the mechanics of the delivery process and contrast it with cash settlement.
- Evaluate the impact of different trading order types.
- Compare and contrast forward and futures contracts.

### Chapter 3. Hedging Strategies Using Futures [FMP-6]

*After completing this reading you should be able to:*

- Define and differentiate between short and long hedges and identify their appropriate uses.
- Describe the arguments for and against hedging and the potential impact of hedging on firm profitability.
- Define the basis and explain the various sources of basis risk, and explain how basis risks arise when hedging with futures.
- Define cross hedging, and compute and interpret the minimum variance hedge ratio and hedge effectiveness.
- Compute the optimal number of futures contracts needed to hedge an exposure, and explain and calculate the “tailing the hedge” adjustment.
- Explain how to use stock index futures contracts to change a stock portfolio's beta.
- Explain how to use stock index futures contracts to lock in the benefit of a stock selection.
- Explain the term “rolling the hedge forward” or “stack and roll” and describe some of the risks that arise from this strategy.

### Chapter 4. Interest Rates [FMP-7]

*After completing this reading you should be able to:*

- Describe Treasury rates, LIBOR, repo rates, and overnight indexed swap (OIS) rates, and explain what is meant by the “risk-free” rate.
- Calculate the value of an investment using different compounding frequencies.
- Convert interest rates based on different compounding frequencies.
- Calculate the theoretical price of a bond using spot rates.
- Derive forward interest rates from a set of spot rates.
- Derive the value of the cash flows from a forward rate agreement (FRA).
- Calculate the duration, modified duration, and dollar duration of a bond.
- Evaluate the limitations of duration and explain how convexity addresses some of them.
- Calculate the change in a bond's price given its duration, its convexity, and a change in interest rates.
- Compare and contrast the major theories of the term structure of interest rates.

### Chapter 5. Determination of Forward and Futures Prices [FMP-8]

*After completing this reading you should be able to:*

- Differentiate between investment and consumption assets.
- Define short-selling and calculate the net profit of a short sale of a dividend-paying stock.
- Describe the differences between forward and futures contracts and explain the relationship between forward and spot prices.
- Calculate the forward price given the underlying asset's spot price, and describe an arbitrage argument between spot and forward prices.
- Explain the relationship between forward and futures prices.
- Explain how an index arbitrage strategy works.
- Calculate a forward foreign exchange rate using the interest rate parity relationship.
- Define income, storage costs, and convenience yield.
- Calculate the futures price on commodities incorporating income/storage costs and/or convenience yields.
- Calculate, using the cost-of-carry model, forward prices where the underlying asset either does or does not have interim cash flows.
- Describe the various delivery options available in the futures markets and how they can influence futures prices.
- Explain the relationship between current futures prices and expected future spot prices, including the impact of systematic and nonsystematic risk.
- Define and interpret contango and backwardation, and explain how they relate to the cost-of-carry model.

**Chapter 6. Interest Rate Futures [FMP-9]***After completing this reading you should be able to:*

- Identify the most commonly used day count conventions, describe the markets that each one is typically used in, and apply each to an interest calculation.
- Calculate the conversion of a discount rate to a price for a US Treasury bill.
- Differentiate between the clean and dirty price for a US Treasury bond; calculate the accrued interest and dirty price on a US Treasury bond.
- Explain and calculate a US Treasury bond futures contract conversion factor.
- Calculate the cost of delivering a bond into a Treasury bond futures contract.
- Describe the impact of the level and shape of the yield curve on the cheapest-to-deliver Treasury bond decision.
- Calculate the theoretical futures price for a Treasury bond futures contract.
- Calculate the final contract price on a Eurodollar futures contract.
- Describe and compute the Eurodollar futures contract convexity adjustment.
- Explain how Eurodollar futures can be used to extend the LIBOR zero curve.
- Calculate the duration-based hedge ratio and create a duration-based hedging strategy using interest rate futures.
- Explain the limitations of using a duration-based hedging strategy.

**Chapter 7. Swaps [FMP-10]***After completing this reading you should be able to:*

- Explain the mechanics of a plain vanilla interest rate swap and compute its cash flows.
- Explain how a plain vanilla interest rate swap can be used to transform an asset or a liability and calculate the resulting cash flows.
- Explain the role of financial intermediaries in the swaps market.
- Describe the role of the confirmation in a swap transaction.
- Describe the comparative advantage argument for the existence of interest rate swaps and evaluate some of the criticisms of this argument.
- Explain how the discount rates in a plain vanilla interest rate swap are computed.
- Calculate the value of a plain vanilla interest rate swap based on two simultaneous bond positions.
- Calculate the value of a plain vanilla interest rate swap from a sequence of forward rate agreements (FRAs).
- Explain the mechanics of a currency swap and compute its cash flows.
- Explain how a currency swap can be used to transform an asset or liability and calculate the resulting cash flows.
- Calculate the value of a currency swap based on two simultaneous bond positions.
- Calculate the value of a currency swap based on a sequence of FRAs.
- Describe the credit risk exposure in a swap position.
- Identify and describe other types of swaps, including commodity, volatility, and exotic swaps.

**Chapter 10. Mechanics of Options Markets [FMP-11]***After completing this reading you should be able to:*

- Describe the types, position variations, and typical underlying assets of options.
- Explain the specification of exchange-traded stock option contracts, including that of nonstandard products.
- Describe how trading, commissions, margin requirements, and exercise typically work for exchange-traded options.



**Chapter 11. Properties of Stock Options [FMP-12]***After completing this reading you should be able to:*

- Identify the six factors that affect an option's price and describe how these six factors affect the price for both European and American options.
- Identify and compute upper and lower bounds for option prices on non-dividend and dividend paying stocks.
- Explain put-call parity and apply it to the valuation of European and American stock options with dividends and without dividends.
- Explain the early exercise features of American call and put options.

**Chapter 12. Trading Strategies Involving Options [FMP-13]***After completing this reading you should be able to:*

- Explain the motivation to initiate a covered call or a protective put strategy.
- Describe the use and calculate the payoffs of various spread strategies.
- Describe the use and explain the payoff functions of combination strategies.

**Chapter 26. Exotic Options [FMP-14]***After completing this reading you should be able to:*

- Define and contrast exotic derivatives and plain vanilla derivatives.
- Describe some of the factors that drive the development of exotic products.
- Explain how any derivative can be converted into a zero-cost product.
- Describe how standard American options can be transformed into nonstandard American options.
- Identify and describe the characteristics and pay-off structure of the following exotic options: gap, forward start, compound, chooser, barrier, binary, lookback, shout, Asian, exchange, rainbow, and basket options.
- Describe and contrast volatility and variance swaps.
- Explain the basic premise of static option replication and how it can be applied to hedging exotic options.

**Robert McDonald, *Derivatives Markets*, 3<sup>rd</sup> Edition (Boston, MA: Addison-Wesley, 2013).****Chapter 6. Commodity Forwards and Futures [FMP-15]***After completing this reading you should be able to:*

- Apply commodity concepts such as storage costs, carry markets, lease rate, and convenience yield.
- Explain the basic equilibrium formula for pricing commodity forwards.
- Describe an arbitrage transaction in commodity forwards, and compute the potential arbitrage profit.
- Define the lease rate and explain how it determines the no-arbitrage values for commodity forwards and futures.
- Define carry markets, and illustrate the impact of storage costs and convenience yields on commodity forward prices and no-arbitrage bounds.
- Compute the forward price of a commodity with storage costs.
- Calculate a continuous lease rate for a commodity asset.
- Explain the relationship between the lease rate, the convenience yield, and the storage cost.
- Identify factors that impact gold, corn, electricity, natural gas, and oil forward prices.
- Compute a commodity spread.
- Explain how basis risk can occur when hedging commodity price exposure.
- Evaluate the differences between a strip hedge and a stack hedge and explain how these differences impact risk management.
- Provide examples of cross-hedging, specifically the process of hedging jet fuel with crude oil and using weather derivatives.
- Explain how to create a synthetic commodity position, and use it to explain the relationship between the forward price and the expected future spot price.

**Jon Gregory, *Central Counterparties: Mandatory Clearing and Bilateral Margin Requirements for OTC Derivatives* (New York, NY: John Wiley & Sons, 2014).**

## **Chapter 2. Exchanges, OTC Derivatives, DPCs and SPVs [FMP-16]**

*After completing this reading you should be able to:*

- Describe how exchanges can be used to alleviate counterparty risk.
- Explain the developments in clearing that reduce risk.
- Compare exchange-traded and OTC markets and describe their uses.
- Identify the classes of derivative securities and explain the risk associated with them.
- Identify risks associated with OTC markets and explain how these risks can be mitigated.
- Explain the use of special purpose vehicles (SPVs) in the OTC derivatives market and the risks associated with them.

## **Chapter 3. Basic Principles of Central Clearing [FMP-17]**

*After completing this reading you should be able to:*

- Provide examples of the mechanics of a central counterparty (CCP).
- Describe advantages and disadvantages of central clearing of OTC derivatives.
- Compare margin requirements in centrally cleared and bilateral markets, and explain how margin can mitigate risk.
- Compare and contrast bilateral markets to the use of novation and netting.
- Assess the impact of central clearing on the broader financial markets.

## **Chapter 14 (Section 14.4 only). Risks Caused by CCPs: Risks Faced by CCPs [FMP-18]**

*After completing this reading you should be able to:*

- Identify and explain the types of risks faced by CCPs.
- Identify and distinguish between the risks to clearing members as well as non-members.
- Identify and evaluate lessons learned from prior CCP failures.

**Anthony Saunders and Marcia Millon Cornett, *Financial Institutions Management: A Risk Management Approach*, 9<sup>th</sup> Edition (New York, NY: McGraw-Hill, 2017).**

## **Chapter 13. Foreign Exchange Risk [FMP-19]**

*After completing this reading you should be able to:*

- Calculate a financial institution's overall foreign exchange exposure.
- Explain how a financial institution could alter its net position exposure to reduce foreign exchange risk.
- Calculate and explain the effect of an appreciation/depreciation of a currency relative to a foreign currency.
- Calculate a financial institution's potential dollar gain or loss exposure to a particular currency.
- Identify and describe the different types of foreign exchange trading activities.
- Identify the sources of foreign exchange trading gains and losses.
- Calculate the potential gain or loss from a foreign currency denominated investment.
- Explain balance-sheet hedging with forwards.
- Describe how a non-arbitrage assumption in the foreign exchange markets leads to the interest rate parity theorem, and use this theorem to calculate forward foreign exchange rates.
- Explain the purchasing power parity theorem and use this theorem to calculate the appreciation or depreciation of a foreign currency.
- Explain why diversification in multi-currency asset liability positions could reduce portfolio risk.
- Describe the relationship between nominal and real interest rates.

**Frank Fabozzi (Editor), *The Handbook of Fixed Income Securities, 8<sup>th</sup> Edition* (New York, NY: McGraw-Hill, 2012).**

**Chapter 12. Corporate Bonds [FMP-20]**

*After completing this reading you should be able to:*

- Describe a bond indenture and explain the role of the corporate trustee in a bond indenture.
- Explain a bond's maturity date and how it impacts bond retirements.
- Describe the main types of interest payment classifications.
- Describe zero-coupon bonds and explain the relationship between original-issue discount and reinvestment risk.
- Distinguish among the following security types relevant for corporate bonds: mortgage bonds, collateral trust bonds, equipment trust certificates, subordinated and convertible debenture bonds, and guaranteed bonds.
- Describe the mechanisms by which corporate bonds can be retired before maturity.
- Differentiate between credit default risk and credit spread risk.
- Describe event risk and explain what may cause it in corporate bonds.
- Define high-yield bonds, and describe types of high-yield bond issuers and some of the payment features unique to high yield bonds.
- Define and differentiate between an issuer default rate and a dollar default rate.
- Define recovery rates and describe the relationship between recovery rates and seniority.

**Bruce Tuckman and Angel Serrat, *Fixed Income Securities: Tools for Today's Markets, 3<sup>rd</sup> Edition* (Hoboken, NJ: John Wiley & Sons, 2011).**

**Chapter 20. Mortgages and Mortgage-Backed Securities [FMP-21]**

*After completing this reading you should be able to:*

- Describe the various types of residential mortgage products.
- Calculate a fixed rate mortgage payment, and its principal and interest components.
- Describe the mortgage prepayment option and the factors that influence prepayments.
- Summarize the securitization process of mortgage backed securities (MBS), particularly formation of mortgage pools including specific pools and TBAs.
- Calculate weighted average coupon, weighted average maturity, and conditional prepayment rate (CPR) for a mortgage pool.
- Describe a dollar roll transaction and how to value a dollar roll.
- Explain prepayment modeling and its four components: refinancing, turnover, defaults, and curtailments.
- Describe the steps in valuing an MBS using Monte Carlo simulation.
- Define Option Adjusted Spread (OAS), and explain its challenges and its uses.
- Describe the effect of the prepayment option on the price-rate behavior of MBS.

# Valuation and Risk Models

## PART I EXAM WEIGHT | 30% (VRM)

### THE BROAD AREAS OF KNOWLEDGE COVERED IN READINGS RELATED TO VALUATION AND RISK MODELS INCLUDE THE FOLLOWING:

- Value-at-Risk (VaR)
- Expected shortfall (ES)
- Stress testing and scenario analysis
- Option valuation
- Fixed income valuation
- Hedging
- Country and sovereign risk models and management
- External and internal credit ratings
- Expected and unexpected losses
- Operational risk

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*The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:*

**Linda Allen, Jacob Boudoukh, and Anthony Saunders, *Understanding Market, Credit and Operational Risk: The Value at Risk Approach* (New York, NY: Wiley-Blackwell, 2004).**

#### **Chapter 2. Quantifying Volatility in a VaR Model [VRM-1]**

*After completing this reading you should be able to:*

- Explain how asset return distributions tend to deviate from the normal distribution.
- Explain reasons for fat tails in a return distribution and describe their implications.
- Distinguish between conditional and unconditional distributions.
- Describe the implications of regime switching on quantifying volatility.
- Evaluate the various approaches for estimating VaR.
- Compare and contrast different parametric and non-parametric approaches for estimating conditional volatility.
- Explain the estimation of conditional volatility using parametric and non-parametric approaches.
- Explain the process of return aggregation in the context of volatility forecasting methods.
- Evaluate implied volatility as a predictor of future volatility and its shortcomings.
- Explain long horizon volatility/VaR and the process of mean reversion according to an AR(1) model.
- Calculate conditional volatility with and without mean reversion.
- Describe the impact of mean reversion on long horizon conditional volatility estimation.

#### **Chapter 3. Putting VaR to Work [VRM-2]**

*After completing this reading you should be able to:*

- Explain and give examples of linear and non-linear derivatives.
- Describe and calculate VaR for linear derivatives.
- Describe the delta-normal approach for calculating VaR for non-linear derivatives.
- Describe the limitations of the delta-normal method.
- Explain the full revaluation method for computing VaR.
- Compare delta-normal and full revaluation approaches for computing VaR.
- Explain structured Monte Carlo, stress testing, and scenario analysis methods for computing VaR, and identify strengths and weaknesses of each approach.
- Describe the implications of correlation breakdown for scenario analysis.
- Describe Worst-Case Scenario (WCS) analysis and compare WCS to VaR.

**Kevin Dowd, *Measuring Market Risk, 2<sup>nd</sup> Edition* (West Sussex, UK: John Wiley & Sons, 2005).**

## **Chapter 2. Measures of Financial Risk [VRM-3]**

*After completing this reading you should be able to:*

- Describe the mean-variance framework and the efficient frontier.
- Explain the limitations of the mean-variance framework with respect to assumptions about return distributions.
- Define the VaR measure of risk, describe assumptions about return distributions and holding period, and explain the limitations of VaR.
- Define the properties of a coherent risk measure and explain the meaning of each property.
- Explain why VaR is not a coherent risk measure.
- Explain and calculate Expected Shortfall (ES), and compare and contrast VaR and ES.
- Describe spectral risk measures, and explain how VaR and ES are special cases of spectral risk measures.
- Describe how the results of scenario analysis can be interpreted as coherent risk measures.

**John C. Hull, *Options, Futures, and Other Derivatives, 10<sup>th</sup> Edition* (New York, NY: Pearson, 2017).**

## **Chapter 13. Binomial Trees [VRM-4]**

*After completing this reading you should be able to:*

- Calculate the value of an American and a European call or put option using a one-step and two-step binomial model.
- Describe how volatility is captured in the binomial model.
- Explain how the parameters necessary to construct a binomial tree match the volatility of the underlying asset.
- Describe how the value calculated using a binomial model converges as time periods are added.
- Explain how the binomial model can be altered to price options on: stocks with dividends, stock indices, currencies, and futures.
- Define and calculate delta of a stock option.

## **Chapter 15. The Black-Scholes-Merton Model [VRM-5]**

*After completing this reading you should be able to:*

- Explain the lognormal property of stock prices, the distribution of rates of return, and the calculation of expected return.
- Compute the realized return and historical volatility of a stock.
- Describe the assumptions underlying the Black-Scholes-Merton option pricing model.
- Compute the value of a European option using the Black-Scholes-Merton model on a non-dividend-paying stock.
- Compute the value of a warrant and identify the complications involving the valuation of warrants.
- Define implied volatilities and describe how to compute implied volatilities from market prices of options using the Black-Scholes-Merton model.
- Explain how dividends affect the decision to exercise early for American call and put options.
- Compute the value of a European option using the Black-Scholes-Merton model on a dividend-paying stock.

**Chapter 19. The Greek Letters [VRM-6]***After completing this reading you should be able to:*

- Describe and assess the risks associated with naked and covered option positions.
- Explain how naked and covered option positions generate a stop loss trading strategy.
- Describe delta hedging for an option, forward, and futures contracts.
- Compute the delta of an option.
- Describe the dynamic aspects of delta hedging and distinguish between dynamic hedging and hedge-and-forget strategy.
- Define and calculate the delta of a portfolio.
- Define and describe theta, gamma, vega, and rho for option positions.
- Explain how to implement and maintain a delta-neutral and a gamma-neutral position.
- Describe the relationship between delta, theta, gamma, and vega.
- Describe how hedging activities take place in practice, and describe how scenario analysis can be used to formulate expected gains and losses with option positions.
- Describe how portfolio insurance can be created through option instruments and stock index futures.

**Bruce Tuckman and Angel Serrat, *Fixed Income Securities: Tools for Today's Markets*, 3<sup>rd</sup> Edition (Hoboken, NJ: John Wiley & Sons, 2011).**

**Chapter 1. Prices, Discount Factors, and Arbitrage [VRM-7]***After completing this reading you should be able to:*

- Define discount factor and use a discount function to compute present and future values.
- Define the “law of one price,” explain it using an arbitrage argument, and describe how it can be applied to bond pricing.
- Identify the components of a US Treasury coupon bond, and compare and contrast the structure to Treasury STRIPS, including the difference between P-STRIPS and C-STRIPS.
- Construct a replicating portfolio using multiple fixed income securities to match the cash flows of a given fixed-income security.
- Identify arbitrage opportunities for fixed income securities with certain cash flows.
- Differentiate between “clean” and “dirty” bond pricing and explain the implications of accrued interest with respect to bond pricing.
- Describe the common day-count conventions used in bond pricing.

**Chapter 2. Spot, Forward and Par Rates [VRM-8]***After completing this reading you should be able to:*

- Calculate and interpret the impact of different compounding frequencies on a bond's value.
- Calculate discount factors given interest rate swap rates.
- Compute spot rates given discount factors.
- Interpret the forward rate, and compute forward rates given spot rates.
- Define par rate and describe the equation for the par rate of a bond.
- Interpret the relationship between spot, forward, and par rates.
- Assess the impact of maturity on the price of a bond and the returns generated by bonds.
- Define the “flattening” and “steepening” of rate curves and describe a trade to reflect expectations that a curve will flatten or steepen.

**Chapter 3. Returns, Spreads and Yields [VRM-9]***After completing this reading you should be able to:*

- Distinguish between gross and net realized returns, and calculate the realized return for a bond over a holding period including reinvestments.
- Define and interpret the spread of a bond, and explain how a spread is derived from a bond price and a term structure of rates.
- Define, interpret, and apply a bond's yield-to-maturity (YTM) to bond pricing.
- Compute a bond's YTM given a bond structure and price.
- Calculate the price of an annuity and a perpetuity.
- Explain the relationship between spot rates and YTM.
- Define the coupon effect and explain the relationship between coupon rate, YTM, and bond prices.
- Explain the decomposition of P&L for a bond into separate factors including carry roll-down, rate change, and spread change effects.
- Identify the most common assumptions in carry roll-down scenarios, including realized forwards, unchanged term structure, and unchanged yields.

**Chapter 4. One-Factor Risk Metrics and Hedges [VRM-10]***After completing this reading you should be able to:*

- Describe an interest rate factor and identify common examples of interest rate factors.
- Define and compute the DV01 of a fixed income security given a change in yield and the resulting change in price.
- Calculate the face amount of bonds required to hedge an option position given the DV01 of each.
- Define, compute, and interpret the effective duration of a fixed income security given a change in yield and the resulting change in price.
- Compare and contrast DV01 and effective duration as measures of price sensitivity.
- Define, compute, and interpret the convexity of a fixed income security given a change in yield and the resulting change in price.
- Explain the process of calculating the effective duration and convexity of a portfolio of fixed income securities.
- Explain the impact of negative convexity on the hedging of fixed income securities.
- Construct a barbell portfolio to match the cost and duration of a given bullet investment, and explain the advantages and disadvantages of bullet versus barbell portfolios.

**Chapter 5. Multi-Factor Risk Metrics and Hedges [VRM-11]***After completing this reading you should be able to:*

- Describe and assess the major weakness attributable to single-factor approaches when hedging portfolios or implementing asset liability techniques.
- Define key rate exposures and know the characteristics of key rate exposure factors including partial '01s and forward-bucket '01s.
- Describe key-rate shift analysis.
- Define, calculate, and interpret key rate '01 and key rate duration.
- Describe the key rate exposure technique in multi-factor hedging applications; summarize its advantages and disadvantages.
- Calculate the key rate exposures for a given security, and compute the appropriate hedging positions given a specific key rate exposure profile.
- Relate key rates, partial '01s and forward-bucket '01s, and calculate the forward-bucket '01 for a shift in rates in one or more buckets.
- Construct an appropriate hedge for a position across its entire range of forward-bucket exposures.
- Apply key rate and multi-factor analysis to estimating portfolio volatility given a correlation for each pair of key rates.



**Aswath Damodaran, “Country Risk: Determinants, Measures and Implications - The 2018 Edition” (July 23, 2018). (pages 1-49 only). [VRM-12]**

*After completing this reading you should be able to:*

- Identify sources of country risk.
- Explain how a country’s position in the economic growth life cycle, political risk, legal risk, and economic structure affect its risk exposure.
- Evaluate composite measures of risk that incorporate all types of country risk and explain limitations of the risk services.
- Compare instances of sovereign default in both foreign currency debt and local currency debt, and explain common causes of sovereign defaults.
- Describe the consequences of sovereign default.
- Describe factors that influence the level of sovereign default risk; explain and assess how rating agencies measure sovereign default risks.
- Describe the advantages and disadvantages of using the sovereign default spread as a predictor of defaults.

**Arnaud de Servigny and Olivier Renault, *Measuring and Managing Credit Risk* (New York, NY: McGraw-Hill, 2004). Chapter 2. External and Internal Ratings [VRM-13]**

*After completing this reading you should be able to:*

- Describe external rating scales, the rating process, and the link between ratings and default.
- Describe the impact of time horizon, economic cycle, industry, and geography on external ratings.
- Explain the potential impact of ratings changes on bond and stock prices.
- Compare external and internal ratings approaches.
- Explain and compare the through-the-cycle and at-the-point internal ratings approaches.
- Describe a ratings transition matrix and explain its uses.
- Describe the process for and issues with building, calibrating, and backtesting an internal rating system.
- Identify and describe the biases that may affect a rating system.

**Gerhard Schroeck, *Risk Management and Value Creation in Financial Institutions* (New York, NY: John Wiley & Sons, 2002).**

**Chapter 5. Capital Structure in Banks (pages 170-186 only) [VRM-14]**

*After completing this reading you should be able to:*

- Evaluate a bank’s economic capital relative to its level of credit risk.
- Identify and describe important factors used to calculate economic capital for credit risk: probability of default, exposure, and loss rate.
- Define and calculate expected loss (EL).
- Define and calculate unexpected loss (UL).
- Estimate the variance of default probability assuming a binomial distribution.
- Calculate UL for a portfolio and the UL contribution of each asset.
- Describe how economic capital is derived.
- Explain how the credit loss distribution is modeled.
- Describe challenges to quantifying credit risk.



**John C. Hull, *Risk Management and Financial Institutions, 5<sup>th</sup> Edition* (Hoboken, NJ: John Wiley & Sons, 2018).**

### **Chapter 23. Operational Risk [VRM-15]**

*After completing this reading you should be able to:*

- Compare three approaches for calculating regulatory capital.
- Describe the Basel Committee's seven categories of operational risk.
- Derive a loss distribution from the loss frequency distribution and loss severity distribution using Monte Carlo simulations.
- Describe the common data issues that can introduce inaccuracies and biases in the estimation of loss frequency and severity distributions.
- Describe how to use scenario analysis in instances when data is scarce.
- Describe how to identify causal relationships and how to use Risk and Control Self-Assessment (RCSA) and Key Risk Indicators (KRIs) to measure and manage operational risks.
- Describe the allocation of operational risk capital to business units.
- Explain how to use the power law to measure operational risk.
- Explain the risks of moral hazard and adverse selection when using insurance to mitigate operational risks.

***Stress Testing: Approaches, Methods, and Applications, Edited by Akhtar Siddique and Iftekhhar Hasan (London, UK: Risk Books, 2013).***

### **Chapter 1. Governance over Stress Testing [VRM-16]**

*After completing this reading you should be able to:*

- Describe the key elements of effective governance over stress testing.
- Describe the responsibilities of the board of directors and senior management in stress testing activities.
- Identify elements of clear and comprehensive policies, procedures, and documentations on stress testing.
- Identify areas of validation and independent review for stress tests that require attention from a governance perspective.
- Describe the important role of the internal audit in stress testing governance and control.
- Identify key aspects of stress testing governance, including stress testing coverage, stress testing types and approaches, and capital and liquidity stress testing.

### **Chapter 2. Stress Testing and Other Risk Management Tools [VRM-17]**

*After completing this reading you should be able to:*

- Describe the relationship between stress testing and other risk measures, particularly in enterprise-wide stress testing.
- Describe the various approaches to using VaR models in stress tests.
- Explain the importance of stressed inputs and their importance in stressed VaR.
- Identify the advantages and disadvantages of stressed risk metrics.

***“Principles for sound stress testing practices and supervision” (Basel Committee on Banking Supervision Publication, May 2009). [VRM-18]***

*After completing this reading you should be able to:*

- Describe the rationale for the use of stress testing as a risk management tool.
- Describe weaknesses identified and recommendations for improvement in:
  - The use of stress testing and integration in risk governance
  - Stress testing methodologies
  - Stress testing scenarios
  - Stress testing handling of specific risks and products
- Describe stress testing principles for banks regarding the use of stress testing and integration in risk governance, stress testing methodology and scenario selection, and principles for supervisors.

# FRM LEARNING OBJECTIVES PART II

# Market Risk Measurement and Management

## PART II EXAM WEIGHT | 25% (MR)

### THE BROAD AREAS OF KNOWLEDGE COVERED IN READINGS RELATED TO MARKET RISK MEASUREMENT AND MANAGEMENT INCLUDE THE FOLLOWING:

- VaR and other risk measures
    - Parametric and non-parametric methods of estimation
    - VaR mapping
    - Backtesting VaR
    - Expected shortfall (ES) and other coherent risk measures
  - Modeling dependence: correlations and copulas
  - Term structure models of interest rates
  - Volatility: smiles and term structures
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*The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:*

**Kevin Dowd, *Measuring Market Risk, 2<sup>nd</sup> Edition* (West Sussex, UK: John Wiley & Sons, 2005).**

#### **Chapter 3. Estimating Market Risk Measures: An Introduction and Overview [MR-1]**

*After completing this reading you should be able to:*

- Estimate VaR using a historical simulation approach.
- Estimate VaR using a parametric approach for both normal and lognormal return distributions.
- Estimate the expected shortfall given P/L or return data.
- Define coherent risk measures.
- Estimate risk measures by estimating quantiles.
- Evaluate estimators of risk measures by estimating their standard errors.
- Interpret QQ plots to identify the characteristics of a distribution.

#### **Chapter 4. Non-parametric Approaches [MR-2]**

*After completing this reading you should be able to:*

- Apply the bootstrap historical simulation approach to estimate coherent risk measures.
- Describe historical simulation using non-parametric density estimation.
- Compare and contrast the age-weighted, the volatility-weighted, the correlation-weighted, and the filtered historical simulation approaches.
- Identify advantages and disadvantages of non-parametric estimation methods.

**Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3<sup>rd</sup> Edition* (New York, NY: McGraw-Hill, 2007).**

#### **Chapter 6. Backtesting VaR [MR-3]**

*After completing this reading you should be able to:*

- Define backtesting and exceptions and explain the importance of backtesting VaR models.
- Explain the significant difficulties in backtesting a VaR model.
- Verify a model based on exceptions or failure rates.
- Define and identify Type I and Type II errors.
- Explain the need to consider conditional coverage in the backtesting framework.
- Describe the Basel rules for backtesting.

**Chapter 11. VaR Mapping [MR-4]***After completing this reading you should be able to:*

- Explain the principles underlying VaR mapping, and describe the mapping process.
- Explain how the mapping process captures general and specific risks.
- Differentiate among the three methods of mapping portfolios of fixed income securities.
- Summarize how to map a fixed income portfolio into positions of standard instruments.
- Describe how mapping of risk factors can support stress testing.
- Explain how VaR can be used as a performance benchmark.
- Describe the method of mapping forwards, forward rate agreements, interest rate swaps, and options.

**“Messages from the academic literature on risk measurement for the trading book,” Basel Committee on Banking Supervision, Working Paper, No. 19, Jan 2011. [MR-5]***After completing this reading you should be able to:*

- Explain the following lessons on VaR implementation: time horizon over which VaR is estimated, the recognition of time varying volatility in VaR risk factors, and VaR backtesting.
- Describe exogenous and endogenous liquidity risk and explain how they might be integrated into VaR models.
- Compare VaR, expected shortfall, and other relevant risk measures.
- Compare unified and compartmentalized risk measurement.
- Compare the results of research on “top-down” and “bottom-up” risk aggregation methods.
- Describe the relationship between leverage, market value of asset, and VaR within an active balance sheet management framework.

**Gunter Meissner, *Correlation Risk Modeling and Management* (New York, NY: John Wiley & Sons, 2014).****Chapter 1. Some Correlation Basics: Properties, Motivation, Terminology [MR-6]***After completing this reading you should be able to:*

- Describe financial correlation risk and the areas in which it appears in finance.
- Explain how correlation contributed to the global financial crisis of 2007 to 2009.
- Describe the structure, uses, and payoffs of a correlation swap.
- Estimate the impact of different correlations between assets in the trading book on the VaR capital charge.
- Explain the role of correlation risk in market risk and credit risk.
- Relate correlation risk to systemic and concentration risk.

**Chapter 2. Empirical Properties of Correlation: How Do Correlations Behave in the Real World? [MR-7]***After completing this reading you should be able to:*

- Describe how equity correlations and correlation volatilities behave throughout various economic states.
- Calculate a mean reversion rate using standard regression and calculate the corresponding autocorrelation.
- Identify the best-fit distribution for equity, bond, and default correlations.

**Chapter 3. Statistical Correlation Models—Can We Apply Them to Finance? [MR-8]***After completing this reading you should be able to:*

- Evaluate the limitations of financial modeling with respect to the model itself, calibration of the model, and the model's output.
- Assess the Pearson correlation approach, Spearman's rank correlation, and Kendall's  $\tau$ , and evaluate their limitations and usefulness in finance.

#### **Chapter 4. Financial Correlation Modeling—Bottom-Up Approaches (Sections 4.3.0 (Intro), 4.3.1, and 4.3.2 only) [MR-9]**

*After completing this reading you should be able to:*

- Explain the purpose of copula functions and the translation of the copula equation.
- Describe the Gaussian copula and explain how to use it to derive the joint probability of default of two assets.
- Summarize the process of finding the default time of an asset correlated to all other assets in a portfolio using the Gaussian copula.

**Bruce Tuckman and Angel Serrat, *Fixed Income Securities: Tools for Today's Markets, 3<sup>rd</sup> Edition* (Hoboken, NJ: John Wiley & Sons, 2011).**

#### **Chapter 6. Empirical Approaches to Risk Metrics and Hedging [MR-10]**

*After completing this reading you should be able to:*

- Explain the drawbacks to using a DV01-neutral hedge for a bond position.
- Describe a regression hedge and explain how it can improve a standard DV01-neutral hedge.
- Calculate the regression hedge adjustment factor, beta.
- Calculate the face value of an offsetting position needed to carry out a regression hedge.
- Calculate the face value of multiple offsetting swap positions needed to carry out a two-variable regression hedge.
- Compare and contrast level and change regressions.
- Describe principal component analysis and explain how it is applied to constructing a hedging portfolio.

#### **Chapter 7. The Science of Term Structure Models [MR-11]**

*After completing this reading you should be able to:*

- Calculate the expected discounted value of a zero-coupon security using a binomial tree.
- Construct and apply an arbitrage argument to price a call option on a zero-coupon security using replicating portfolios.
- Define risk-neutral pricing and apply it to option pricing.
- Distinguish between true and risk-neutral probabilities, and apply this difference to interest rate drift.
- Explain how the principles of arbitrage pricing of derivatives on fixed income securities can be extended over multiple periods.
- Define option-adjusted spread (OAS) and apply it to security pricing.
- Describe the rationale behind the use of recombining trees in option pricing.
- Calculate the value of a constant maturity Treasury swap, given an interest rate tree and the risk-neutral probabilities.
- Evaluate the advantages and disadvantages of reducing the size of the time steps on the pricing of derivatives on fixed-income securities.
- Evaluate the appropriateness of the Black-Scholes-Merton model when valuing derivatives on fixed income securities.

#### **Chapter 8. The Evolution of Short Rates and the Shape of the Term Structure [MR-12]**

*After completing this reading you should be able to:*

- Explain the role of interest rate expectations in determining the shape of the term structure.
- Apply a risk-neutral interest rate tree to assess the effect of volatility on the shape of the term structure.
- Estimate the convexity effect using Jensen's inequality.
- Evaluate the impact of changes in maturity, yield, and volatility on the convexity of a security.
- Calculate the price and return of a zero coupon bond incorporating a risk premium.

**Chapter 9. The Art of Term Structure Models: Drift [MR-13]***After completing this reading you should be able to:*

- Construct and describe the effectiveness of a short-term interest rate tree assuming normally distributed rates, both with and without drift.
- Calculate the short-term rate change and standard deviation of the rate change using a model with normally distributed rates and no drift.
- Describe methods for addressing the possibility of negative short-term rates in term structure models.
- Construct a short-term rate tree under the Ho-Lee Model with time-dependent drift.
- Describe uses and benefits of the arbitrage-free models and assess the issue of fitting models to market prices.
- Describe the process of constructing a simple and recombining tree for a short-term rate under the Vasicek Model with mean reversion.
- Calculate the Vasicek Model rate change, standard deviation of the rate change, expected rate in T years, and half-life.
- Describe the effectiveness of the Vasicek Model.

**Chapter 10. The Art of Term Structure Models: Volatility and Distribution [MR-14]***After completing this reading you should be able to:*

- Describe the short-term rate process under a model with time-dependent volatility.
- Calculate the short-term rate change and determine the behavior of the standard deviation of the rate change using a model with time dependent volatility.
- Assess the efficacy of time-dependent volatility models.
- Describe the short-term rate process under the Cox-Ingersoll-Ross (CIR) and lognormal models.
- Calculate the short-term rate change and describe the basis point volatility using the CIR and lognormal models.
- Describe lognormal models with deterministic drift and mean reversion.

**John C. Hull, *Options, Futures, and Other Derivatives, 10<sup>th</sup> Edition* (New York, NY: Pearson, 2017).****Chapter 20. Volatility Smiles [MR-15]***After completing this reading you should be able to:*

- Define volatility smile and volatility skew.
- Explain the implications of put-call parity on the implied volatility of call and put options.
- Compare the shape of the volatility smile (or skew) to the shape of the implied distribution of the underlying asset price and to the pricing of options on the underlying asset.
- Describe characteristics of foreign exchange rate distributions and their implications on option prices and implied volatility.
- Describe the volatility smile for equity options and foreign currency options and provide possible explanations for its shape.
- Describe alternative ways of characterizing the volatility smile.
- Describe volatility term structures and volatility surfaces and how they may be used to price options.
- Explain the impact of the volatility smile on the calculation of the “Greeks”.
- Explain the impact of a single asset price jump on a volatility smile.

# Credit Risk Measurement and Management

## PART II EXAM WEIGHT | 25% (CR)

### THE BROAD AREAS OF KNOWLEDGE COVERED IN READINGS RELATED TO CREDIT RISK MEASUREMENT AND MANAGEMENT INCLUDE THE FOLLOWING:

- Credit analysis
- Default risk: Quantitative methodologies
- Expected and unexpected loss
- Credit VaR
- Counterparty risk
- Credit derivatives
- Structured finance and securitization

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*The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:*

**Jonathan Golin and Philippe Delhaise, *The Bank Credit Analysis Handbook, 2<sup>nd</sup> Edition* (Hoboken, NJ: John Wiley & Sons, 2013).**

#### **Chapter 1. The Credit Decision [CR-1]**

*After completing this reading you should be able to:*

- Define credit risk and explain how it arises using examples.
- Explain the components of credit risk evaluation.
- Describe, compare and contrast various credit risk mitigants and their role in credit analysis.
- Compare and contrast quantitative and qualitative techniques of credit risk evaluation.
- Compare the credit analysis of consumers, corporations, financial institutions, and sovereigns.
- Describe quantitative measurements and factors of credit risk, including probability of default, loss given default, exposure at default, expected loss, and time horizon.
- Compare bank failure and bank insolvency.

#### **Chapter 2. The Credit Analyst [CR-2]**

*After completing this reading you should be able to:*

- Describe, compare and contrast various credit analyst roles.
- Describe common tasks performed by a banking credit analyst.
- Describe the quantitative, qualitative, and research skills a banking credit analyst is expected to have.
- Assess the quality of various sources of information used by a credit analyst.

**Giacomo De Laurentis, Renato Maino, and Luca Molteni, *Developing, Validating and Using Internal Ratings* (West Sussex, UK: John Wiley & Sons, 2010).**

#### **Chapter 2. Classifications and Key Concepts of Credit Risk [CR-3]**

*After completing this reading you should be able to:*

- Describe the role of ratings in credit risk management.
- Describe classifications of credit risk and their correlation with other financial risks.
- Define default risk, recovery risk, exposure risk and calculate exposure at default.
- Explain expected loss, unexpected loss, VaR, and concentration risk, and describe the differences among them.
- Define risk-adjusted pricing and determine risk-adjusted return on risk-adjusted capital (RARORAC).

### Chapter 3. Ratings Assignment Methodologies [CR-4]

*After completing this reading you should be able to:*

- Explain the key features of a good rating system.
- Describe the experts-based approaches, statistical-based models, and numerical approaches to predicting default.
- Describe a rating migration matrix and calculate the probability of default, cumulative probability of default, marginal probability of default, and annualized default rate.
- Describe rating agencies' assignment methodologies for issue and issuer ratings.
- Describe the relationship between borrower rating and probability of default.
- Compare agencies' ratings to internal experts-based rating systems.
- Distinguish between the structural approaches and the reduced-form approaches to predicting default.
- Apply the Merton model to calculate default probability and the distance to default and describe the limitations of using the Merton model.
- Describe linear discriminant analysis (LDA), define the Z-score and its usage, and apply LDA to classify a sample of firms by credit quality.
- Describe the application of a logistic regression model to estimate default probability.
- Define and interpret cluster analysis and principal component analysis.
- Describe the use of a cash flow simulation model in assigning rating and default probability, and explain the limitations of the model.
- Describe the application of heuristic approaches, numeric approaches, and artificial neural networks in modeling default risk and define their strengths and weaknesses.
- Describe the role and management of qualitative information in assessing probability of default.

**René Stulz, *Risk Management & Derivatives* (Florence, KY: Thomson South-Western, 2002).**

### Chapter 18. Credit Risks and Credit Derivatives [CR-5]

*After completing this reading you should be able to:*

- Using the Merton model, calculate the value of a firm's debt and equity and the volatility of firm value.
- Explain the relationship between credit spreads, time to maturity, and interest rates, and calculate credit spread.
- Explain the differences between valuing senior and subordinated debt using a contingent claim approach.
- Explain, from a contingent claim perspective, the impact of stochastic interest rates on the valuation of risky bonds, equity, and the risk of default.
- Compare and contrast different approaches to credit risk modeling, such as those related to the Merton model, CreditRisk+, CreditMetrics, and the KMV model.
- Assess the credit risks of derivatives.
- Describe a credit derivative, credit default swap, and total return swap.
- Explain how to account for credit risk exposure in valuing a swap.



Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011).

### Chapter 7. Spread Risk and Default Intensity Models [CR-6]

*After completing this reading you should be able to:*

- Compare the different ways of representing credit spreads.
- Compute one credit spread given others when possible.
- Define and compute the Spread '01.
- Explain how default risk for a single company can be modeled as a Bernoulli trial.
- Explain the relationship between exponential and Poisson distributions.
- Define the hazard rate and use it to define probability functions for default time and conditional default probabilities.
- Calculate the unconditional default probability and the conditional default probability given the hazard rate.
- Calculate risk-neutral default rates from spreads.
- Describe advantages of using the CDS market to estimate hazard rates.
- Explain how a CDS spread can be used to derive a hazard rate curve.
- Explain how the default distribution is affected by the sloping of the spread curve.
- Define spread risk and its measurement using the mark-to-market and spread volatility.

### Chapter 8. Portfolio Credit Risk (Sections 8.1, 8.2, 8.3 only) [CR-7]

*After completing this reading you should be able to:*

- Define and calculate default correlation for credit portfolios.
- Identify drawbacks in using the correlation-based credit portfolio framework.
- Assess the impact of correlation on a credit portfolio and its Credit VaR.
- Describe the use of a single-factor model to measure portfolio credit risk, including the impact of correlation.
- Define and calculate Credit VaR.
- Describe how Credit VaR can be calculated using a simulation of joint defaults.
- Assess the effect of granularity on Credit VaR.

### Chapter 9. Structured Credit Risk [CR-8]

*After completing this reading you should be able to:*

- Describe common types of structured products.
- Describe tranching and the distribution of credit losses in a securitization.
- Describe a waterfall structure in a securitization.
- Identify the key participants in the securitization process, and describe conflicts of interest that can arise in the process.
- Compute and evaluate one or two iterations of interim cashflows in a three-tiered securitization structure.
- Describe a simulation approach to calculating credit losses for different tranches in a securitization.
- Explain how the default probabilities and default correlations affect the credit risk in a securitization.
- Explain how default sensitivities for tranches are measured.
- Describe risk factors that impact structured products.
- Define implied correlation and describe how it can be measured.
- Identify the motivations for using structured credit products.

**Jon Gregory, *The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital*, 3<sup>rd</sup> Edition (West Sussex, UK: John Wiley & Sons, 2015).**

#### **Chapter 4. Counterparty Risk [CR-9]**

*After completing this reading you should be able to:*

- Describe counterparty risk and differentiate it from lending risk.
- Describe transactions that carry counterparty risk and explain how counterparty risk can arise in each transaction.
- Identify and describe institutions that take on significant counterparty risk.
- Describe credit exposure, credit migration, recovery, mark-to-market, replacement cost, default probability, loss given default, and the recovery rate.
- Describe credit value adjustment (CVA) and compare the use of CVA and credit limits in evaluating and mitigating counterparty risk.
- Identify and describe the different ways institutions can quantify, manage and mitigate counterparty risk.
- Identify and explain the costs of an OTC derivative.
- Explain the components of the xVA term.

#### **Chapter 5. Netting, Close-out, and Related Aspects [CR-10]**

*After completing this reading you should be able to:*

- Explain the purpose of an ISDA master agreement.
- Summarize netting and close-out procedures (including multilateral netting), explain their advantages and disadvantages, and describe how they fit into the framework of the ISDA master agreement.
- Describe the effectiveness of netting in reducing credit exposure under various scenarios.
- Describe the mechanics of termination provisions and trade compressions and explain their advantages and disadvantages.
- Identify and describe termination events and discuss their potential effects on parties to a transaction.

#### **Chapter 6. Collateral [CR-11]**

*After completing this reading you should be able to:*

- Describe the rationale for collateral management.
- Describe the terms of a collateral and features of a credit support annex (CSA) within the ISDA Master Agreement including threshold, initial margin, minimum transfer amount and rounding, haircuts, credit quality, and credit support amount.
- Describe the role of a valuation agent.
- Describe the mechanics of collateral and the types of collateral that are typically used.
- Explain the process for the reconciliation of collateral disputes.
- Explain the features of a collateralization agreement.
- Differentiate between a two-way and one-way CSA agreement and describe how collateral parameters can be linked to credit quality.
- Explain aspects of collateral including funding, rehypothecation and segregation.
- Explain how market risk, operational risk, and liquidity risk (including funding liquidity risk) can arise through collateralization.

**Chapter 7. Credit Exposure and Funding [CR-12]***After completing this reading you should be able to:*

- Describe and calculate the following metrics for credit exposure: expected mark-to-market, expected exposure, potential future exposure, expected positive exposure and negative exposure, effective exposure, and maximum exposure.
- Compare the characterization of credit exposure to VaR methods and describe additional considerations used in the determination of credit exposure.
- Identify factors that affect the calculation of the credit exposure profile and summarize the impact of collateral on exposure.
- Identify typical credit exposure profiles for various derivative contracts and combination profiles.
- Explain how payment frequencies and exercise dates affect the exposure profile of various securities.
- Explain the impact of netting on exposure, the benefit of correlation, and calculate the netting factor.
- Explain the impact of collateralization on exposure, and assess the risk associated with the remargining period, threshold, and minimum transfer amount.
- Assess the impact of collateral on counterparty risk and funding, with and without segregation or rehypothecation.

**Chapter 9. Counterparty Risk Intermediation [CR-13]***After completing this reading you should be able to:*

- Identify counterparty risk intermediaries including central counterparties (CCPs), derivative product companies (DPCs), special purpose vehicles (SPVs), and monoline insurance companies (monolines) and describe their roles.
- Describe the risk management process of a CCP and explain the loss waterfall structure of a CCP.
- Compare bilateral and centrally cleared over-the-counter (OTC) derivative markets.
- Assess the capital requirements for a qualifying CCP and discuss the advantages and disadvantages of CCPs.
- Discuss the impact of central clearing on credit value adjustment (CVA), funding value adjustment (FVA), capital value adjustment (KVA), and margin value adjustment (MVA).

**Chapter 12. Default Probabilities, Credit Spreads, and Funding Costs [CR-14]***After completing this reading you should be able to:*

- Distinguish between cumulative and marginal default probabilities.
- Calculate risk-neutral default probabilities, and compare the use of risk-neutral and real-world default probabilities in pricing derivative contracts.
- Compare the various approaches for estimating price: historical data approach, equity based approach, and risk neutral approach.
- Describe how recovery rates may be estimated.
- Describe credit default swaps (CDS) and their general underlying mechanics.
- Describe the credit spread curve and explain the motivation for curve mapping.
- Describe types of portfolio credit derivatives.
- Describe index tranches, super senior risk, and collateralized debt obligations (CDO).

**Chapter 14. Credit and Debt Value Adjustments [CR-15]***After completing this reading you should be able to:*

- Explain the motivation for and the challenges of pricing counterparty risk.
- Describe credit value adjustment (CVA).
- Calculate CVA and the CVA spread with no wrong-way risk, netting, or collateralization.
- Evaluate the impact of changes in the credit spread and recovery rate assumptions on CVA.
- Explain how netting can be incorporated into the CVA calculation.
- Define and calculate incremental CVA and marginal CVA, and explain how to convert CVA into a running spread
- Explain the impact of incorporating collateralization into the CVA calculation.
- Describe debt value adjustment (DVA) and bilateral CVA (BCVA).
- Calculate BCVA and BCVA spread.

**Chapter 17. Wrong-way Risk [CR-16]***After completing this reading you should be able to:*

- Describe wrong-way risk and contrast it with right-way risk.
- Identify examples of wrong-way risk and examples of right-way risk.
- Discuss the impact of collateral on wrong-way risk.
- Discuss the impact of wrong-way risk on central counterparties.

***Stress Testing: Approaches, Methods, and Applications, Edited by Akhtar Siddique and Iftekhar Hasan (London, UK: Risk Books, 2013).***

**Chapter 4. The Evolution of Stress Testing Counterparty Exposures [CR-17]***After completing this reading you should be able to:*

- Differentiate among current exposure, peak exposure, expected exposure, and expected positive exposure.
- Explain the treatment of counterparty credit risk (CCR) both as a credit risk and as a market risk and describe its implications for trading activities and risk management for a financial institution.
- Describe a stress test that can be performed on a loan portfolio and on a derivative portfolio.
- Calculate the stressed expected loss, the stress loss for the loan portfolio and the stress loss on a derivative portfolio.
- Describe a stress test that can be performed on CVA.
- Calculate the stressed CVA and the stress loss on CVA.
- Calculate the DVA and explain how stressing DVA enters into aggregating stress tests of CCR.
- Describe the common pitfalls in stress testing CCR.

**Michel Crouhy, Dan Galai and Robert Mark, *The Essentials of Risk Management, 2<sup>nd</sup> Edition* (New York, NY: McGraw-Hill, 2014).**

### **Chapter 9. Credit Scoring and Retail Credit Risk Management [CR-18]**

*After completing this reading you should be able to:*

- Analyze the credit risks and other risks generated by retail banking.
- Explain the differences between retail credit risk and corporate credit risk.
- Discuss the “dark side” of retail credit risk and the measures that attempt to address the problem.
- Define and describe credit risk scoring model types, key variables, and applications.
- Discuss the key variables in a mortgage credit assessment and describe the use of cutoff scores, default rates, and loss rates in a credit scoring model.
- Discuss the measurement and monitoring of a scorecard performance including the use of cumulative accuracy profile (CAP) and the accuracy ratio (AR) techniques.
- Describe the customer relationship cycle and discuss the trade-off between creditworthiness and profitability.
- Discuss the benefits of risk-based pricing of financial services.

### **Chapter 12. The Credit Transfer Markets and Their Implications [CR-19]**

*After completing this reading you should be able to:*

- Discuss the flaws in the securitization of subprime mortgages prior to the financial crisis of 2007.
- Identify and explain the different techniques used to mitigate credit risk, and describe how some of these techniques are changing the bank credit function.
- Describe the originate-to-distribute model of credit risk transfer and discuss the two ways of managing a bank credit portfolio.
- Describe the different types and structures of credit derivatives including credit default swaps (CDS), first-to-default puts, total return swaps (TRS), asset-backed credit-linked notes (CLN), and their applications.
- Explain the credit risk securitization process and describe the structure of typical collateralized loan obligations (CLOs) or collateralized debt obligations (CDOs).
- Describe synthetic CDOs and single-tranche CDOs.
- Assess the rating of CDOs by rating agencies prior to the 2007 financial crisis.

**Moorad Choudhry, *Structured Credit Products: Credit Derivatives & Synthetic Securitization, 2<sup>nd</sup> Edition* (New York, NY: John Wiley & Sons, 2010).**

### **Chapter 12. An Introduction to Securitization [CR-20]**

*After completing this reading you should be able to:*

- Define securitization, describe the securitization process, and explain the role of participants in the process.
- Explain the terms over-collateralization, first-loss piece, equity piece, and cash waterfall within the securitization process.
- Analyze the differences in the mechanics of issuing securitized products using a trust versus a special purpose vehicle (SPV) and distinguish between the three main SPV structures: amortizing, revolving, and master trust.
- Explain the reasons for and the benefits of undertaking securitization.
- Describe and assess the various types of credit enhancements.
- Explain the various performance analysis tools for securitized structures and identify the asset classes they are most applicable to.
- Define and calculate the delinquency ratio, default ratio, monthly payment rate (MPR), debt service coverage ratio (DSCR), the weighted average coupon (WAC), the weighted average maturity (WAM), and the weighted average life (WAL) for relevant securitized structures.
- Explain the prepayment forecasting methodologies and calculate the constant prepayment rate (CPR) and the Public Securities Association (PSA) rate.
- Explain the decline in demand for new-issue securitized finance products following the 2007 financial crisis.

**Adam Ashcraft and Til Schuermann, “Understanding the Securitization of Subprime Mortgage Credit,” Federal Reserve Bank of New York Staff Reports, No. 318 (March 2008). [CR-21]**

*After completing this reading you should be able to:*

- Explain the subprime mortgage credit securitization process in the United States.
- Identify and describe key frictions in subprime mortgage securitization, and assess the relative contribution of each factor to the subprime mortgage problems.
- Describe the characteristics of the subprime mortgage market, including the creditworthiness of the typical borrower and the features and performance of a subprime loan.
- Describe the credit ratings process with respect to subprime mortgage backed securities.
- Explain the implications of credit ratings on the emergence of subprime related mortgage backed securities.
- Describe the relationship between the credit ratings cycle and the housing cycle.
- Explain the implications of the subprime mortgage meltdown on portfolio management.
- Compare predatory lending and borrowing.

# Operational and Integrated Risk Management

## PART II EXAM WEIGHT | 25% (OR)

### THE BROAD AREAS OF KNOWLEDGE COVERED IN READINGS RELATED TO OPERATIONAL AND INTEGRATED RISK MANAGEMENT INCLUDE THE FOLLOWING:

- Principles for sound operational risk management
- Enterprise Risk Management (ERM) and enterprise-wide risk governance
- IT infrastructure and data quality
- Internal and external operational loss data
- Methods of determining operational risk capital for regulatory purposes
- Model risk and model validation
- Extreme value theory (EVT)
- Risk-adjusted return on capital (RAROC)
- Economic capital frameworks and capital planning
- Liquidity risk measurement and management
- Failure mechanics of dealer banks
- Stress testing banks
- Third-party outsourcing risk
- Risks related to money laundering and financing of terrorism
- Regulation and the Basel Accords

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*The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:*

#### **“Principles for the Sound Management of Operational Risk,” (Basel Committee on Banking Supervision Publication, June 2011). [OR-1]**

***After completing this reading you should be able to:***

- Describe the three “lines of defense” in the Basel model for operational risk governance.
- Summarize the fundamental principles of operational risk management as suggested by the Basel Committee.
- Explain guidelines for strong governance of operational risk, and evaluate the role of the board of directors and senior management in implementing an effective operational risk framework.
- Describe tools and processes that can be used to identify and assess operational risk.
- Describe features of an effective control environment and identify specific controls that should be in place to address operational risk.
- Explain the Basel Committee’s suggestions for managing technology risk and outsourcing risk.

**Brian Nocco and René Stulz, “Enterprise Risk Management: Theory and Practice,” *Journal of Applied Corporate Finance* 18 (2006): 18(4), 8–20. [OR–2]**

*After completing this reading you should be able to:*

- Define enterprise risk management (ERM) and explain how implementing ERM practices and policies can create shareholder value, both at the macro and the micro level.
- Explain how a company can determine its optimal amount of risk through the use of credit rating targets.
- Describe the development and implementation of an ERM system, as well as challenges to the implementation of an ERM system.
- Describe the role of and issues with correlation in risk aggregation, and describe typical properties of a firm's market risk, credit risk, and operational risk distributions.
- Distinguish between regulatory and economic capital, and explain the use of economic capital in the corporate decision making process.

**“Observations on Developments in Risk Appetite Frameworks and IT Infrastructure,” *Senior Supervisors Group*, December 2010. [OR–3]**

*After completing this reading you should be able to:*

- Describe the concept of a risk appetite framework (RAF), identify the elements of an RAF, and explain the benefits to a firm of having a well-developed RAF.
- Describe best practices for a firm's Chief Risk Officer (CRO), Chief Executive Officer (CEO), and its board of directors in the development and implementation of an effective RAF.
- Explain the role of an RAF in managing the risk of individual business lines within a firm, and describe best practices for monitoring a firm's risk profile for adherence to the RAF.
- Explain the benefits to a firm from having a robust risk data infrastructure, and describe key elements of an effective IT risk management policy at a firm.
- Describe factors that can lead to poor or fragmented IT infrastructure at an organization.
- Explain the challenges and best practices related to data aggregation at an organization.

**Anthony Tarantino and Deborah Cernauskas, *Risk Management in Finance: Six Sigma and Other Next Generation Techniques* (Hoboken, NJ: John Wiley & Sons, 2009).**

**Chapter 3. Information Risk and Data Quality Management [OR–4]**

*After completing this reading you should be able to:*

- Identify the most common issues that result in data errors.
- Explain how a firm can set expectations for its data quality and describe some key dimensions of data quality used in this process.
- Describe the operational data governance process, including the use of scorecards in managing information risk.



**Marcelo G. Cruz, Gareth W. Peters, and Pavel V. Shevchenko, *Fundamental Aspects of Operational Risk and Insurance Analytics: A Handbook of Operational Risk* (Hoboken, NJ: John Wiley & Sons, 2015).**

**Chapter 2: OpRisk Data and Governance [OR-5]**

*After completing this reading you should be able to:*

- Describe the seven Basel II event risk categories and identify examples of operational risk events in each category.
- Summarize the process of collecting and reporting internal operational loss data, including the selection of thresholds, the timeframe for recoveries, and reporting expected operational losses.
- Explain the use of a Risk Control Self Assessment (RCSA) and key risk indicators (KRIs) in identifying, controlling, and assessing operational risk exposures.
- Describe and assess the use of scenario analysis in managing operational risk, and identify biases and challenges that can arise when using scenario analysis.
- Compare the typical operational risk profiles of firms in different financial sectors.
- Explain the role of operational risk governance and explain how a firm's organizational structure can impact risk governance.

**Philippa X. Girling, *Operational Risk Management: A Complete Guide to a Successful Operational Risk Framework* (Hoboken, NJ: John Wiley & Sons, 2013).**

**Chapter 8. External Loss Data [OR-6]**

*After completing this reading you should be able to:*

- Explain the motivations for using external operational loss data and common sources of external data.
- Explain ways in which data from different external sources may differ.
- Describe challenges that can arise through the use of external data.
- Describe the Société Générale operational loss event and explain the lessons learned from the event.

**Chapter 12. Capital Modeling [OR-7]**

*After completing this reading you should be able to:*

- Compare the basic indicator approach, the standardized approach, and the alternative standardized approach for calculating the operational risk capital charge, and calculate the Basel operational risk charge using each approach.
- Describe the modeling requirements for a bank to use the Advanced Measurement Approach (AMA).
- Describe the loss distribution approach to modeling operational risk capital.
- Explain how frequency and severity distributions of operational losses are obtained, including commonly used distributions and suitability guidelines for probability distributions.
- Explain how Monte Carlo simulation can be used to generate additional data points to estimate the 99.9<sup>th</sup> percentile of an operational loss distribution.
- Explain the use of scenario analysis and the hybrid approach in modeling operational risk capital.

**Kevin Dowd, *Measuring Market Risk, 2<sup>nd</sup> Edition* (West Sussex, UK: John Wiley & Sons, 2005).**

**Chapter 7. Parametric Approaches (II): Extreme Value [OR-8]**

*After completing this reading you should be able to:*

- Explain the importance and challenges of extreme values in risk management.
- Describe extreme value theory (EVT) and its use in risk management.
- Describe the peaks-over-threshold (POT) approach.
- Compare and contrast generalized extreme value and POT.
- Evaluate the tradeoffs involved in setting the threshold level when applying the GP distribution.
- Explain the importance of multivariate EVT for risk management.

**Giacomo De Laurentis, Renato Maino, Luca Molteni, *Developing, Validating and Using Internal Ratings* (Hoboken, NJ: John Wiley & Sons, 2010).**

### **Chapter 5. Validating Rating Models [OR-9]**

*After completing this reading you should be able to:*

- Explain the process of model validation and describe best practices for the roles of internal organizational units in the validation process.
- Compare qualitative and quantitative processes to validate internal ratings, and describe elements of each process.
- Describe challenges related to data quality and explain steps that can be taken to validate a model's data quality.
- Explain how to validate the calibration and the discriminatory power of a rating model.

**Michel Crouhy, Dan Galai and Robert Mark, *The Essentials of Risk Management, 2<sup>nd</sup> Edition* (New York, NY: McGraw-Hill, 2014).**

### **Chapter 15. Model Risk [OR-10]**

*After completing this reading you should be able to:*

- Identify and explain errors in modeling assumptions that can introduce model risk.
- Explain how model risk can arise in the implementation of a model.
- Explain methods and procedures risk managers can use to mitigate model risk.
- Explain the impact of model risk and poor risk governance in the 2012 London Whale trading loss and the 1998 collapse of Long Term Capital Management.

### **Chapter 17. Risk Capital Attribution and Risk-Adjusted Performance Measurement [OR-11]**

*After completing this reading you should be able to:*

- Define, compare, and contrast risk capital, economic capital, and regulatory capital, and explain methods and motivations for using economic capital approaches to allocate risk capital.
- Describe the RAROC (risk-adjusted return on capital) methodology and its use in capital budgeting.
- Compute and interpret the RAROC for a project, loan, or loan portfolio, and use RAROC to compare business unit performance.
- Explain challenges that arise when using RAROC for performance measurement, including choosing a time horizon, measuring default probability, and choosing a confidence level.
- Calculate the hurdle rate and apply this rate in making business decisions using RAROC.
- Compute the adjusted RAROC for a project to determine its viability.
- Explain challenges in modeling diversification benefits, including aggregating a firm's risk capital and allocating economic capital to different business lines.
- Explain best practices in implementing an approach that uses RAROC to allocate economic capital.

**“Range of practices and issues in economic capital frameworks,” (Basel Committee on Banking Supervision Publication, March 2009). [OR-12]**

*After completing this reading you should be able to:*

- Within the economic capital implementation framework describe the challenges that appear in:
  - Defining and calculating risk measures
  - Risk aggregation
  - Validation of models
  - Dependency modeling in credit risk
  - Evaluating counterparty credit risk
  - Assessing interest rate risk in the banking book
- Describe the BIS recommendations that supervisors should consider to make effective use of internal risk measures, such as economic capital, that are not designed for regulatory purposes.
- Explain benefits and impacts of using an economic capital framework within the following areas:
  - Credit portfolio management
  - Risk based pricing
  - Customer profitability analysis
  - Management incentives
- Describe best practices and assess key concerns for the governance of an economic capital framework.

**“Capital Planning at Large Bank Holding Companies: Supervisory Expectations and Range of Current Practice,” Board of Governors of the Federal Reserve System, August 2013. [OR-13]**

*After completing this reading you should be able to:*

- Describe the Federal Reserve’s Capital Plan Rule and explain the seven principles of an effective capital adequacy process for bank holding companies (BHCs) subject to the Capital Plan Rule.
- Describe practices that can result in a strong and effective capital adequacy process for a BHC in the following areas:
  - Risk identification
  - Internal controls, including model review and validation
  - Corporate governance
  - Capital policy, including setting of goals and targets and contingency planning
  - Stress testing and stress scenario design
  - Estimating losses, revenues, and expenses, including quantitative and qualitative methodologies
  - Assessing the impact of capital adequacy, including risk-weighted asset (RWA) and balance sheet projections

**Bruce Tuckman and Angel Serrat, *Fixed Income Securities: Tools for Today’s Markets*, 3<sup>rd</sup> Edition (Hoboken, NJ: John Wiley & Sons, 2011).**

**Chapter 12. Repurchase Agreements and Financing [OR-14]**

*After completing this reading you should be able to:*

- Describe the mechanics of repurchase agreements (repos) and calculate the settlement for a repo transaction.
- Explain common motivations for entering into repos, including their use in cash management and liquidity management.
- Explain how counterparty risk and liquidity risk can arise through the use of repo transactions.
- Assess the role of repo transactions in the collapses of Lehman Brothers and Bear Stearns during the 2007 - 2009 credit crisis.
- Compare the use of general and special collateral in repo transactions.
- Describe the characteristics of special spreads and explain the typical behavior of US Treasury special spreads over an auction cycle.
- Calculate the financing advantage of a bond trading special when used in a repo transaction.

**Kevin Dowd, *Measuring Market Risk, 2<sup>nd</sup> Edition* (West Sussex, UK: John Wiley & Sons, 2005).**

#### **Chapter 14. Estimating Liquidity Risks [OR-15]**

*After completing this reading you should be able to:*

- Define liquidity risk and describe factors that influence liquidity, including the bid-ask spread.
- Differentiate between exogenous and endogenous liquidity.
- Describe the challenges of estimating liquidity-adjusted VaR (LVaR).
- Describe and calculate LVaR using the constant spread approach and the exogenous spread approach.
- Describe endogenous price approaches to LVaR, their motivation and limitations, and calculate the elasticity-based liquidity adjustment to VaR.
- Describe liquidity at risk (LaR) and compare it to LVaR and VaR, describe the factors that affect future cash flows, and explain challenges in estimating and modeling LaR.
- Describe approaches to estimate liquidity risk during crisis situations and challenges which can arise during this process.

**Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011).**

#### **Chapter 11. Section 11.1. Assessing the Quality of Risk Measures [OR-16]**

*After completing this reading you should be able to:*

- Describe ways that errors can be introduced into models.
- Explain how model risk and variability can arise through the implementation of VaR models and the mapping of risk factors to portfolio positions.
- Identify reasons for the failure of the long-equity tranche, short-mezzanine credit trade in 2005 and describe how such modeling errors could have been avoided.
- Explain major defects in model assumptions that led to the underestimation of systematic risk for residential mortgage backed securities (RMBS) during the 2007 - 2009 financial downturn.

#### **Chapter 12. Liquidity and Leverage [OR-17]**

*After completing this reading you should be able to:*

- Differentiate between sources of liquidity risk, including balance sheet/funding liquidity risk, systematic funding liquidity risk, and transactions liquidity risk, and explain how each of these risks can arise for financial institutions.
- Summarize the asset-liability management process at a fractional reserve bank, including the process of liquidity transformation.
- Describe specific liquidity challenges faced by money market mutual funds and by hedge funds, particularly in stress situations.
- Compare transactions used in the collateral market and explain risks that can arise through collateral market transactions.
- Describe the relationship between leverage and a firm's return profile, calculate the leverage ratio, and explain the leverage effect.
- Explain the impact on a firm's leverage and its balance sheet of the following transactions: purchasing long equity positions on margin, entering into short sales, and trading in derivatives.
- Explain methods to measure and manage funding liquidity risk and transactions liquidity risk.
- Calculate the expected transactions cost and the spread risk factor for a transaction, and calculate the liquidity adjustment to VaR for a position to be liquidated over a number of trading days.
- Explain interactions between different types of liquidity risk and explain how liquidity risk events can increase systemic risk.

**Darrell Duffie, “The Failure Mechanics of Dealer Banks,” *Journal of Economic Perspectives* (2010): 24(1), 51-72.****[OR- 18]*****After completing this reading you should be able to:***

- Describe the major lines of business in which dealer banks operate and the risk factors they face in each line of business.
- Identify situations that can cause a liquidity crisis at a dealer bank and explain responses that can mitigate these risks.
- Describe policy measures that can alleviate firm-specific and systemic risks related to large dealer banks.

**“Stress Testing Banks,” Til Schuermann, prepared for the Committee on Capital Market Regulation, Wharton Financial Institutions Center (April 2012). [OR-19]*****After completing this reading you should be able to:***

- Describe the historical evolution of the stress testing process and compare methodologies of historical EBA, CCAR and SCAP stress tests.
- Explain challenges in designing stress test scenarios, including the problem of coherence in modeling risk factors.
- Explain challenges in modeling a bank’s revenues, losses, and its balance sheet over a stress test horizon period.

**“Guidance on Managing Outsourcing Risk,” Board of Governors of the Federal Reserve System, December 2013. [OR-20]*****After completing this reading you should be able to:***

- Explain how risks can arise through outsourcing activities to third-party service providers, and describe elements of an effective program to manage outsourcing risk.
- Explain how financial institutions should perform due diligence on third-party service providers.
- Describe topics and provisions that should be addressed in a contract with a third-party service provider.

**John C. Hull, *Risk Management and Financial Institutions*, 5<sup>th</sup> Edition (Hoboken, NJ: John Wiley & Sons, 2018).****Chapter 15. Basel I, Basel II, and Solvency II [OR-21]*****After completing this reading you should be able to:***

- Explain the motivations for introducing the Basel regulations, including key risk exposures addressed, and explain the reasons for revisions to Basel regulations over time.
- Explain the calculation of risk-weighted assets and the capital requirement per the original Basel I guidelines.
- Summarize the impact of netting on credit exposure and calculate the net replacement ratio.
- Describe and contrast the major elements—including a description of the risks covered—of the two options available for the calculation of market risk capital:
  - Standardized Measurement Method
  - Internal Models Approach
- Calculate VaR and the capital charge using the internal models approach, and explain the guidelines for backtesting VaR.
- Describe and contrast the major elements of the three options available for the calculation of credit risk capital:
  - Standardized Approach
  - Foundation IRB Approach
  - Advanced IRB Approach
- Describe and contrast the major elements of the three options available for the calculation of operational risk capital: basic indicator approach, standardized approach, and the Advanced Measurement Approach.
- Describe the key elements of the three pillars of Basel II: minimum capital requirements, supervisory review, and market discipline.
- Apply and calculate the worst-case default rate (WCDR) in the context of Basel II.
- Differentiate between solvency capital requirements (SCR) and minimum capital requirements (MCR) in the Solvency II framework, and describe the repercussions to an insurance company for breaching the SCR and MCR.
- Compare the standardized approach and the Internal Models Approach for calculating the SCR in Solvency II.

**Chapter 16. Basel II.5, Basel III, and Other Post-Crisis Changes [OR-22]***After completing this reading you should be able to:*

- Describe and calculate the stressed VaR introduced in Basel II.5, and calculate the market risk capital charge.
- Explain the process of calculating the incremental risk capital charge for positions held in a bank's trading book.
- Describe the comprehensive risk measure (CRM) for positions that are sensitive to correlations between default risks.
- Define in the context of Basel III and calculate where appropriate:
  - Tier 1 capital and its components
  - Tier 2 capital and its components
  - Required Tier 1 equity capital, total Tier 1 capital, and total capital
- Describe the motivations for and calculate the capital conservation buffer and the countercyclical buffer introduced in Basel III.
- Describe and calculate ratios intended to improve the management of liquidity risk, including the required leverage ratio, the liquidity coverage ratio, and the net stable funding ratio.
- Describe regulations for global systemically important banks (G-SIBs), including incremental capital requirements and total loss-absorbing capacity (TLAC).
- Describe the mechanics of contingent convertible bonds (CoCos) and explain the motivations for banks to issue them.
- Explain the major changes to the US financial market regulations as a result of Dodd-Frank, and compare Dodd-Frank regulations to regulations in other countries.

**Chapter 17. Regulation of the OTC Derivatives Market [OR-23]***After completing this reading you should be able to:*

- Summarize the clearing process in OTC derivative markets.
- Describe changes to the regulation of OTC derivatives which took place after the 2007–2009 financial crisis and explain the impact of these changes.

**Chapter 18. Fundamental Review of the Trading Book [OR-24]***After completing this reading you should be able to:*

- Describe the changes to the Basel framework for calculating market risk capital under the Fundamental Review of the Trading Book (FRTB), and the motivations for these changes.
- Compare the various liquidity horizons proposed by the FRTB for different asset classes and explain how a bank can calculate its expected shortfall using the various horizons.
- Explain the FRTB revisions to Basel regulations in the following areas:
  - Classification of positions in the trading book compared to the banking book
  - Backtesting, profit and loss attribution, credit risk, and securitizations

**“High-level summary of Basel III reforms,” (Basel Committee on Banking Supervision Publication, December 2017). [OR-25]***After completing this reading you should be able to:*

- Explain the motivations for revising the Basel III framework and the goals and impacts of the December 2017 reforms to the Basel III framework.
- Summarize the December 2017 revisions to the Basel III framework in the following areas:
  - The standardized approach to credit risk
  - The internal ratings-based (IRB) approaches for credit risk
  - The CVA risk framework
  - The operational risk framework
  - The leverage ratio framework
- Describe the revised output floor introduced as part of the Basel III reforms and approaches to be used when calculating the output floor.

**“Basel III: Finalising post-crisis reforms,” (Basel Committee on Banking Supervision Publication, December 2017): 128–136. [OR-26]**

*After completing this reading you should be able to:*

- Explain the elements of the new standardized approach to measure operational risk capital, including the business indicator, internal loss multiplier, and loss component, and calculate the operational risk capital requirement for a bank using this approach.
- Compare the SMA to earlier methods of calculating operational risk capital, including the Advanced Measurement Approaches (AMA).
- Describe general and specific criteria recommended by the Basel Committee for the identification, collection, and treatment of operational loss data.

**“Sound management of risks related to money laundering and financing of terrorism,” (Basel Committee on Banking Supervision, June 2017). (pages 1–32 only) [OR-27]**

*After completing this reading you should be able to:*

- Explain best practices recommended by the Basel Committee for the assessment, management, mitigation and monitoring of money laundering and financial terrorism (ML/FT) risks.
- Describe recommended practices for the acceptance, verification and identification of customers at a bank.
- Explain practices for managing ML/FT risks in a group-wide and cross-border context, and describe the roles and responsibilities of supervisors in managing these risks.
- Explain policies and procedures a bank should use to manage ML/FT risks in situations where it uses a third party to perform customer due diligence and when engaging in correspondent banking.

**Optional Regulatory Readings for Reference (online only)**

Candidates are expected to understand the objective and general structure of important international regulatory frameworks and general application of the various approaches for calculating minimum capital requirements, as described in the readings above. Candidates interested in the complete regulatory framework can review the following:

**“Basel II: International Convergence of Capital Measurement and Capital Standards: A Revised Framework—Comprehensive Version,” (Basel Committee on Banking Supervision Publication, June 2006).\***

**“Basel III: A global regulatory framework for more resilient banks and banking systems—revised version,” (Basel Committee on Banking Supervision Publication, June 2011).\***

**“Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools,” (Basel Committee on Banking Supervision Publication, January 2013).\***

**“Revisions to the Basel II market risk framework—updated as of 31 December 2010,” (Basel Committee on Banking Supervision Publication, February 2011).\***

**“Basel III: the net stable funding ratio.” (Basel Committee on Banking Supervision Publication, October 2014).\***

**“Minimum capital requirements for market risk” (Basel Committee on Banking Supervision Publication, January 2016).\***

**“Basel III: Finalising post-crisis reforms,” (Basel Committee on Banking Supervision Publication, December 2017).\***

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\*This reading is freely available on the GARP website.



# Risk Management and Investment Management

## PART II EXAM WEIGHT | 15% (IM)

### THE BROAD AREAS OF KNOWLEDGE COVERED IN READINGS RELATED TO RISK MANAGEMENT AND INVESTMENT MANAGEMENT INCLUDE THE FOLLOWING:

- Factor theory
- Portfolio construction
- Portfolio risk measures
- Risk budgeting
- Risk monitoring and performance measurement
- Portfolio-based performance analysis
- Hedge funds

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*The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:*

**Andrew Ang, *Asset Management: A Systematic Approach to Factor Investing* (New York, NY: Oxford University Press, 2014).**

#### **Chapter 6. Factor Theory [IM-1]**

*After completing this reading you should be able to:*

- Provide examples of factors that impact asset prices, and explain the theory of factor risk premiums.
- Describe the capital asset pricing model (CAPM) including its assumptions, and explain how factor risk is addressed in the CAPM.
- Explain implications of using the CAPM to value assets, including equilibrium and optimal holdings, exposure to factor risk, its treatment of diversification benefits, and shortcomings of the CAPM.
- Describe multifactor models, and compare and contrast multifactor models to the CAPM.
- Explain how stochastic discount factors are created and apply them in the valuation of assets.
- Describe efficient market theory and explain how markets can be inefficient.

#### **Chapter 7. Factors [IM-2]**

*After completing this reading you should be able to:*

- Describe the process of value investing, and explain reasons why a value premium may exist.
- Explain how different macroeconomic risk factors, including economic growth, inflation, and volatility, affect risk premiums and asset returns.
- Assess methods of mitigating volatility risk in a portfolio, and describe challenges that arise when managing volatility risk.
- Explain how dynamic risk factors can be used in a multifactor model of asset returns, using the Fama-French model as an example.
- Compare value and momentum investment strategies, including their risk and return profiles.



**Chapter 10. Alpha (and the Low-Risk Anomaly) [IM-3]***After completing this reading you should be able to:*

- Describe and evaluate the low-risk anomaly of asset returns.
- Define and calculate alpha, tracking error, the information ratio, and the Sharpe ratio.
- Explain the impact of benchmark choice on alpha, and describe characteristics of an effective benchmark to measure alpha.
- Describe Grinold's fundamental law of active management, including its assumptions and limitations, and calculate the information ratio using this law.
- Apply a factor regression to construct a benchmark with multiple factors, measure a portfolio's sensitivity to those factors and measure alpha against that benchmark.
- Explain how to measure time-varying factor exposures and their use in style analysis.
- Describe issues that arise when measuring alphas for nonlinear strategies.
- Compare the volatility anomaly and beta anomaly, and analyze evidence of each anomaly.
- Describe potential explanations for the risk anomaly.

**Chapter 13. Illiquid Assets [IM-4]***After completing this reading you should be able to:*

- Evaluate the characteristics of illiquid markets.
- Examine the relationship between market imperfections and illiquidity.
- Assess the impact of biases on reported returns for illiquid assets.
- Describe the unsmoothing of returns and its properties.
- Compare illiquidity risk premiums across and within asset categories.
- Evaluate portfolio choice decisions on the inclusion of illiquid assets.

**Richard Grinold and Ronald Kahn, *Active Portfolio Management: A Quantitative Approach for Producing Superior Returns and Controlling Risk*, 2<sup>nd</sup> Edition (New York, NY: McGraw-Hill, 2000).**

**Chapter 14. Portfolio Construction [IM-5]***After completing this reading you should be able to:*

- Distinguish among the inputs to the portfolio construction process.
- Evaluate the methods and motivation for refining alphas in the implementation process.
- Describe neutralization and methods for refining alphas to be neutral.
- Describe the implications of transaction costs on portfolio construction.
- Assess the impact of practical issues in portfolio construction, such as determination of risk aversion, incorporation of specific risk aversion, and proper alpha coverage.
- Describe portfolio revisions and rebalancing, and evaluate the tradeoffs between alpha, risk, transaction costs, and time horizon.
- Determine the optimal no-trade region for rebalancing with transaction costs.
- Evaluate the strengths and weaknesses of the following portfolio construction techniques: screens, stratification, linear programming, and quadratic programming.
- Describe dispersion, explain its causes, and describe methods for controlling forms of dispersion.

**Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3<sup>rd</sup> Edition* (New York, NY: McGraw-Hill, 2007).**

### **Chapter 7. Portfolio Risk: Analytical Methods [IM-6]**

*After completing this reading you should be able to:*

- Define, calculate, and distinguish between the following portfolio VaR measures: individual VaR, incremental VaR, marginal VaR, component VaR, undiversified portfolio VaR, and diversified portfolio VaR.
- Explain the role of correlation on portfolio risk.
- Describe the challenges associated with VaR measurement as portfolio size increases.
- Apply the concept of marginal VaR to guide decisions about portfolio VaR.
- Explain the risk-minimizing position and the risk and return-optimizing position of a portfolio.
- Explain the difference between risk management and portfolio management, and describe how to use marginal VaR in portfolio management.

### **Chapter 17. VaR and Risk Budgeting in Investment Management [IM-7]**

*After completing this reading you should be able to:*

- Define risk budgeting.
- Describe the impact of horizon, turnover, and leverage on the risk management process in the investment management industry.
- Describe the investment process of large investors such as pension funds.
- Describe the risk management challenges associated with investments in hedge funds.
- Distinguish among the following types of risk: absolute risk, relative risk, policy-mix risk, active management risk, funding risk, and sponsor risk.
- Apply VaR to check compliance, monitor risk budgets, and reverse engineer sources of risk.
- Explain how VaR can be used in the investment process and the development of investment guidelines.
- Describe the risk budgeting process and calculate risk budgets across asset classes and active managers.

**Robert Litterman and the Quantitative Resources Group, *Modern Investment Management: An Equilibrium Approach* (Hoboken, NJ: John Wiley & Sons, 2003).**

### **Chapter 17. Risk Monitoring and Performance Measurement [IM-8]**

*After completing this reading you should be able to:*

- Define, compare, and contrast VaR and tracking error as risk measures.
- Describe risk planning, including its objectives, effects, and the participants in its development.
- Describe risk budgeting and the role of quantitative methods in risk budgeting.
- Describe risk monitoring and its role in an internal control environment.
- Identify sources of risk consciousness within an organization.
- Describe the objectives and actions of a risk management unit in an investment management firm.
- Describe how risk monitoring can confirm that investment activities are consistent with expectations.
- Explain the importance of liquidity considerations for a portfolio.
- Describe the use of alpha, benchmark, and peer group as inputs in performance measurement tools.
- Describe the objectives of performance measurement.

**Zvi Bodie, Alex Kane, and Alan J. Marcus, *Investments, 11<sup>th</sup> Edition* (New York, NY: McGraw-Hill, 2017).**

#### **Chapter 24. Portfolio Performance Evaluation [IM-9]**

*After completing this reading you should be able to:*

- Differentiate between time-weighted and dollar-weighted returns of a portfolio and describe their appropriate uses.
- Describe and distinguish between risk-adjusted performance measures, such as Sharpe's measure, Treynor's measure, Jensen's measure (Jensen's alpha), and information ratio.
- Describe the uses for the Modigliani-squared and Treynor's measure in comparing two portfolios, and the graphical representation of these measures.
- Determine the statistical significance of a performance measure using standard error and the t-statistic.
- Explain the difficulties in measuring the performance of hedge funds.
- Describe style analysis.
- Explain how changes in portfolio risk levels can affect the use of the Sharpe ratio to measure performance.
- Describe techniques to measure the market timing ability of fund managers with a regression and with a call option model, and compute return due to market timing.
- Describe and apply performance attribution procedures, including the asset allocation decision, sector and security selection decision, and the aggregate contribution.

**G. Constantinides, M. Harris and R. Stulz, eds., *Handbook of the Economics of Finance, Volume 2B* (Oxford, UK: Elsevier, 2013).**

#### **Chapter 17. Hedge Funds [IM-10]**

*After completing this reading you should be able to:*

- Describe the characteristics of hedge funds and the hedge fund industry, and compare hedge funds with mutual funds.
- Explain biases that are commonly found in databases of hedge funds.
- Explain the evolution of the hedge fund industry and describe landmark events that precipitated major changes in the development of the industry.
- Evaluate the role of investors in shaping the hedge fund industry.
- Explain the relationship between risk and alpha in hedge funds.
- Compare and contrast the different hedge fund strategies, describe their return characteristics, and describe the inherent risks of each strategy.
- Describe the historical portfolio construction and performance trend of hedge funds compared to equity indices.
- Describe market events that resulted in a convergence of risk factors for different hedge fund strategies, and explain the impact of such a convergence on portfolio diversification strategies.
- Describe the problem of risk sharing asymmetry between principals and agents in the hedge fund industry.
- Explain the impact of institutional investors on the hedge fund industry and assess reasons for the growing concentration of assets under management (AUM) in the industry.

**Kevin R. Mirabile, *Hedge Fund Investing: A Practical Approach to Understanding Investor Motivation, Manager Profits, and Fund Performance, 2<sup>nd</sup> Edition* (Hoboken, NJ: Wiley Finance, 2016).**

#### **Chapter 12. Performing Due Diligence on Specific Managers and Funds [IM-11]**

*After completing this reading you should be able to:*

- Identify reasons for the failures of funds in the past.
- Explain elements of the due diligence process used to assess investment managers.
- Identify themes and questions investors can consider when evaluating a manager.
- Describe criteria that can be evaluated in assessing a fund's risk management process.
- Explain how due diligence can be performed on a fund's operational environment.
- Explain how a fund's business model risk and its fraud risk can be assessed.
- Describe elements that can be included as part of a due diligence questionnaire.

# Current Issues in Financial Markets

## PART II EXAM WEIGHT | 10% (CI)

### THE BROAD AREAS OF KNOWLEDGE COVERED IN READINGS RELATED TO CURRENT ISSUES IN FINANCIAL MARKETS INCLUDE THE FOLLOWING:

- Cyber risk
- Artificial intelligence (AI), machine learning and “big data”
- Fintech Revolution
- Central clearing and risk transformation
- Secured Overnight Financing Rate (SOFR)

*The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:*

**Emanuel Kopp, Lincoln Kaffenberger, and Christopher Wilson, “Cyber Risk, Market Failures, and Financial Stability,” (August 2017). IMF Working Paper No. 17/185.\* [CI-1]**

*After completing this reading you should be able to:*

- Evaluate the private market’s ability to provide the socially optimal level of cybersecurity.
- Describe how systemic cyber risk interacts with financial stability risk.
- Evaluate the appropriateness of current regulatory frameworks and supervisory approaches to the reduction of systemic risk.
- Evaluate measures that can help increase resiliency to cyber risk.

**Hal Varian, “Big Data: New Tricks for Econometrics,” Journal of Economic Perspectives (Spring 2014): 28(2), 3-28.\* [CI-2]**

*After completing this reading you should be able to:*

- Describe the issues unique to big datasets.
- Explain and assess different tools and techniques for manipulating and analyzing big data.
- Examine the areas for collaboration between econometrics and machine learning.

**Bart van Liebergen, “Machine Learning: A Revolution in Risk Management and Compliance?” Institute of International Finance, April 2017.\* [CI-3]**

*After completing this reading you should be able to:*

- Describe the process of machine learning and compare machine learning approaches.
- Describe the application of machine learning approaches within the financial services sector and the types of problems to which they can be applied.
- Analyze the application of machine learning in three use cases:
  - Credit risk and revenue modeling
  - Fraud
  - Surveillance of conduct and market abuse in trading

\*This reading is freely available on the GARP website.

**“Artificial intelligence and machine learning in financial services,” Financial Stability Board, Nov. 1, 2017.\* [CI-4]*****After completing this reading you should be able to:***

- Describe the drivers that have contributed to the growing use of Fintech and the supply and demand factors that have spurred adoption of AI and machine learning in financial services.
- Describe the use of AI and machine learning in the following cases:
  - (i) customer-focused uses
  - (ii) operations-focused uses
  - (iii) trading and portfolio management in financial markets
  - (iv) uses for regulatory compliance
- Describe the possible effects and potential benefits and risks of AI and machine learning on financial markets and how they may affect financial stability.

**Peter Gomber, Robert J. Kauffman, Chris Parker, and Bruce Weber, “On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption and Transformation in Financial Services,” Journal of Management Information Systems, (2018): 35(1), 220-265.\* [CI-5]*****After completing this reading you should be able to:***

- Describe how fintech is changing operations management in financial services.
- Explain how fintech innovations have impacted lending and deposit services.
- Describe how fintech innovations have begun to leverage the execution and stakeholder value associated with payments settlement, cryptocurrencies, blockchain technologies, and cross-border payment services.
- Examine the issues with respect to investments, financial markets, trading, risk management, robo-advisory, and related services that are influenced by blockchain and fintech innovations.

**Rama Cont, “Central clearing and risk transformation,” Norges Bank Research, March 2017.\* [CI-6]*****After completing this reading you should be able to:***

- Examine how the clearing of over-the-counter transactions through central counterparties has affected risks in the financial system.
- Assess whether central clearing has enhanced financial stability and reduced systemic risk.
- Describe the transformation of counterparty risk into liquidity risk.
- Explain how liquidity of clearing members and liquidity resources of CCPs affect risk management and financial stability.
- Compare and assess methods a CCP can use to help recover capital when a member defaults or when a liquidity crisis occurs.

**“What is SOFR?” CME Group, March 2018.\* [CI-7]*****After completing this reading you should be able to:***

- Explain the Secured Overnight Financing Rate (SOFR) and its underlying transaction pool.
- Compare the underlying interest rate exposures for SOFR futures and other short-term interest rate futures.

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\*This reading is freely available on the GARP website.



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**New York**

111 Town Square Place  
14<sup>th</sup> floor  
Jersey City, New Jersey  
07310 USA  
+1 201.719.7210

**London**

17 Devonshire Square  
4<sup>th</sup> floor  
London, EC2M 4SQ  
UK  
+44 (0) 20.7397.9630

**Washington D.C.**

1001 19<sup>th</sup> Street North  
#1200  
Arlington, Virginia  
22209 USA  
+1 703.420.0920

**Beijing**

Unit 1010 Financial Street Centre  
No 9A, Financial Street  
Xicheng District  
Beijing 100033 P.R. China  
+86 (010) 5737.9835

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